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The American Street Railway Association. THE twelfth annual meeting of the American Street Railway Association, which convenes at Milwaukee on Wednesday, Oct. 18, promises to equal in interest any of the previous gatherings of this organization. The programme is an attractive one to street railway men, and the reports are upon practical subjects and deal with many of the problems which are agitating the street railway world to-day. It is to be earnestly hoped that they may be supplemented by vigorous discussions, for after all it is the knowledge and experience of the men gathered there from every section of the country and interested in many different systems that is wanted. Milwaukee is happily chosen as the Convention City, for its system of street railways is one of the largest, most thoroughly organized and efficiently operated in the country, and the opportunities for its inspection so courteously extended to the delegates is one of the features of the meeting. The hospitality of Milwaukee is well known, and all those who attend the convention are assured of being gracefully and heartily entertained.

Trolley Overhead Lines. IN this issue we publish the first installment of an article by Lieutenant Cahoon on the maintenance of overhead lines in electric street railways, which will repay the most careful reading, as the writer has had unusual opportunities to acquire knowledge of the facts whereof he writes. It is shown that the same principles apply to the overhead line as were established in former articles for the power plant and care of car motors, which may be summed up in the statement that economy does not consist in the employment of cheap materials and unskilled supervision—a statement so self-evident that it seems extraordinary that street railway practice should be so often carried on in direct conflict with it. It is undoubtedly true that in time many or all of the points criticised will come to be considered in their true light through comparison with the maintenance expenses of street railways conducted on rational and therefore economical principles. A little attention at present, however, by managing officials to details with the assistance of competent professional advice to properly interpret any matters that seem difficult or ambiguous, would greatly advance this time with corresponding profit to the road and pleasure to its patrons. The good will of patrons of a road, as pointed out by Lieutenant Cahoon, is a matter of no little moment. An electric railway is in a certain sense a public interest, and, therefore, unlike a purely private business, is held to be legitimately subject to public criticism. As this criticism, if uniformly unfavorable, may lead not only to loss of traffic but to opposition projects and interference from local governing bodies, it certainly is wise to look carefully into such matters, particularly as any ameliorations that may result, besides forestalling criticism, may also cause an actual decrease of maintenance expenses.

Mr. Stump's Sacrifice. THIS week's report of the Martin case finishes Mr. Martin's effort in his attempted "vindication" of himself and his conduct. This effort was curiously enough commenced by the testimony of the treasurer of Mr. Martin's journal, a man who we suppose had no interest whatever in his controversy, and who from his own evidence it appears knew very little about the facts, for he said he could not recollect them, but who was willing to aid Mr. Martin to such an extent that Mr. Martin thought he would not need anything more. In this expectation, as we have seen, Mr. Martin was disappointed; but, as to-day's report shows, he closed his case and put the finishing touches on his exertions with the testimony of Mr. Clarence E. Stump, and a queer contribution it makes to this already queer story. Mr. Stump's interest in Mr. Martin's welfare as a litigant must have been something more than the ordinary or every day friendliness. It led him to expose himself and to submit while under cross-examination to making, with more openness than feeling for his own interests, one or two strange and humiliating confessions. This as an effort to aid a friend or fulfill an obligation was all very creditable, and as to the wisdom of it we suppose Mr. Stump himself was best qualified to judge of that. It will be remembered that in one part of what we have written about these proceedings we said that all the men who were close to Mr. Johnston at the time of this Martin and Wetzler trouble, and whom Mr. Johnston trusted implicitly, appear to have resolved to stand or fall together. If in this supposition we were correct, Mr. Stump certainly proved faithful to the compact. His fidelity to Mr. Martin and the others was tested to the extent of subjecting himself to making the admissions which he did on the witness stand—no slight test to the ordinary man. From there he has told us, without apparent consciousness that what he said might in any way reflect upon himself, that he asked Mr. Johnston to advance him $4,000 for the stock which he held in the company, but which he did not at the time entirely own, and, upon Mr. Johnston agreeing to make the advance, he then entered into a new agreement to remain with the company for five years. The fulfillment of this agreement would have been the equivalent of the fulfillment of the agreement giving him the right to acquire the ownership of the entire 100 shares of stock. But Mr. Stump, having secured the $4,000, did not carry out the new agreement, although he admitted that Mr. Johnston paid him the amount for the small portion—20 shares—of the stock which he owned and his future prospect of owning the balance—80 shares. There is no pretense that he ever carried out the agreement which gave him the right to acquire these 80 shares; but he secured a portion, and necessarily a large portion, of the $4,000 for them, and thereby he took what he himself called "his future prospect" in this part of the stock entirely out of the uncertainty of the future, and made it very certain and secure in his own hands in the present. "When I asked Mr. Johnston to advance me the $4,000," says Mr. Stump, "*I told him I wanted to use it for paying off a mortgage on my house.*" And he adds, as though he thought this addition was creditable, "*that was not the reason I made the sale.*" There may be a finesse of distinction between these two answers which, we suppose, was satisfactory to the conscience of Mr. Stump, but not being properly educated in this art of spinning out distinctions we must confess that we fail to understand it. A case which was begun by the testimony of the treasurer of the *Electrical Engineer*, as a sort of proxy witness for the plaintiff, who hesitated and wavered about taking upon himself the risk of telling the court himself as a witness what his cause of action was, in every way fitly and properly closed with the remarkable exhibition which Mr. Stump made upon the witness stand. In both these instances friendship itself is personified. The treasurer of the *Electrical Engineer* had, of course, no interest in this personal litigation; and Mr. Stump volunteered us the assurance, attested by his oath, that he was entirely without "hostile feelings." Mr. Stump's performance, we are afraid, was as ill advised as all of Mr. Martin's, and it displays all through it somewhat the same sort of weakness which was shown by those who were left in charge to protect the affairs of THE ELECTRICAL WORLD when the president of the company was absent, leaving the coast clear for Mr. Martin to secure his mandamus, and thereby his examination of the books and papers of the company, to enable him to be enlightened as to the value of "his stock," and to secure some other information heretofore alluded to, equally desirable, and perhaps a little more needful.

A. I. E. E. Local Meetings. A WESTERN contemporary editorially discusses the subject of local meetings of the American Institute of Electrical Engineers in a manner not only illogical and ill-natured, but with an unusual display of ignorance. "It is evident," it remarks, "that the Chicago committee does not contemplate the organization of a body on an equal footing with the New York association, but merely the establishment of a local branch, a dependency under the control of the Eastern members, taking its orders from the older body, discussing such papers as may be sent out for that purpose, and if perchance an ambitious member of the branch have the temerity to prepare a paper it must be submitted to the parent organization, trimmed and 'edited' to meet the views of the gentlemen who are conferring these privileges upon the Chicago fraternity, before it can be published in the *Transactions*." Apparently confounding length of sentence with strength of argument the sapient writer asks if such a programme will not result in the loss of many of the older Western members, and concludes that the cordial support heretofore offered to the Institute throughout the West would cease through fear of contributing to the support and glorification of the New York body. It winds up with the prophecy that the local "branches" would sink into insignificance as the result of this attempt to add to the importance of the New York meetings. Had the writer followed this question, he would know that the demand for local meetings has come from members outside of New York, and that the result of the adoption of any plan yet proposed will curtail, instead of add to, the importance of the New York meeting. Were the New York members inspired with the same petty spirit displayed by the writer quoted, they would not have lent a willing ear to the justice of a demand that will deprive their meeting of its national character and give it a merely local one. If a local meeting is now called under Rule VI. by application to the secretary, it will have practically the same status as the New York meeting. The formation of local meetings may cause the rules to be so modified as to only permit the transaction of business affecting the Institute proper at the annual meeting of the Institute, which, however, would affect the New York meeting the same as the one at Chicago or elsewhere. Our touchy Chicago colleague seems to have confounded the national organization of the Institute with the New York meeting, for which perhaps the present conditions offer some reason, but it seems paradoxical that he should cry out against disturbing these conditions. We cannot think he would duplicate the national organization in each locality, as that, he must recognize, would inevitably lead to the disintegration of the Institute as a national body. If the Institute is to retain its national character it must have some central body to conduct its routine business, and necessity requires that the working members of that body shall reside near together, and their headquarters is fixed in any locality by preponderance of members. Had Chicago more than the 248 members of the New York meeting instead of less than 50 members, the headquarters would probably be at Chicago, and we feel sure that New York would submit to the inevitable consequence with better grace than our Western contemporary shows. The Institute is a professional organization, and any measure affecting it should only be viewed from a professional standpoint. Can any one imagine that the professional character of the Institute or the professional benefit to be derived from it would be otherwise than deteriorated, if, instead of the papers being drawn from a body of 742 members, as at present, and as proposed in several plans now being discussed, their preparation were instead confined to a few score members? A glance at the list of Institute papers for several years will show that the New York local members, even from the large territory the proposed programme still allows it, would not have made a showing to attract national attention, and, as the supply of really creditable papers is limited by circumstances, the most persistent effort would not have supplied the deficit. Has anything in the history of Chicago electrical organizations shown that as great benefit may be continuously derived through local papers as through papers selected from a national membership? We regret to note the spirit shown by our Chicago contemporary, in subordinating to mere feelings of local jealousy a question that should be considered in a broad and enlightened manner—a spirit that implies a singular absence of the mental qualities usually associated with men of professional character and devoted to the interests of their profession.

The Neutralization of Self-Induction by Capacity.

BY ALEXANDER D. LUNT.

In alternating current circuits containing resistance, self-induction and capacity, in series, the phase of the current with respect to the impressed E. M. F. is determined by the relative values of the capacity and self-induction. The self-induction tends to retard the phase of the current so as to lag behind that of the impressed E. M. F. The action of the condenser causes exactly the opposite effect, so that, by a proper proportioning of capacity to self-induction, the circuit may be made to act as though it contained resistance only.

The following solution of the problem is believed by the writer to be simpler and less involved than those usually given, and, as such, is of interest:

Let

e = impressed harmonic E. M. F.

i = current.

C = capacity.

L = coefficient of self-induction.

ω = angular velocity $= 2\pi n$, where n = periodicity.

R = resistance, t = time.

The equation of E. M. Fs. is readily written:

$$e = R\,i + L\,\frac{di}{dt} + \int \frac{i\,dt}{C}$$

differentiating to free from the integral,

$$\frac{de}{L\,dt} = \frac{R\,di}{L\,dt} + \frac{d^2i}{dt^2} + \frac{i}{L\,C}$$

To fulfil the conditions, it is required that

$$e = R\,i$$

and

$$de = R\,di,$$

Substituting,

$$\frac{R\,di}{L\,dt} = \frac{R\,di}{L\,dt} + \frac{d^2i}{dt^2} + \frac{i}{L\,C};$$

but

$$i = I \sin \omega\, t$$

$$\frac{di}{dt} = \omega\, I \cos \omega\, t$$

$$\frac{d^2i}{dt^2} = -\omega^2\, I \sin \omega t.$$

Hence $\omega^2\, I \sin \omega\, t = \dfrac{i}{L\,C}$

and

$$\omega = \frac{I}{\sqrt{L\,C}}.$$

This last may be written

$$T = 2\,\pi\,\sqrt{L\,C}$$

(where T is the time of one period).

These conditions represent the required relations of capacity to self-induction in order to annul the effects of self-induction.

Bursting of a Twenty-Ton Flywheel.

The flywheel of one of the large engines in the power-house of the Atlantic Avenue Railroad at Third Avenue and Second street, Brooklyn, broke into a thousand fragments at 7:30 P. M., Oct. 12. The wheel was 18 feet in diameter and weighed about twenty tons. The wheel's bursting nearly demolished the power station, as the accompanying illustration so strikingly shows, partly wrecked a house several blocks distant, broke in doors and windows in other houses, and injured three persons. The power-house is a two-story brick building, with a frontage of 75 feet on Third avenue, and extending back to a depth of 200 feet. There are eight dynamos, and the wrecked flywheel was the last in the row, and only a few yards from the rear end of the building. When the accident occurred the day men had just gone and the night men were preparing to take their places. Most of them were at the other end of the building. Some fragments of the broken wheel flew through the iron roof, and others through the side walls of the building, carrying the bricks and mortar down in a deluge. Masses of iron weighing all the way from two tons to one hundred pounds were hurled a distance of two blocks. Some big fragments crushed through the roof of the two-story frame house two blocks away. There were a dozen people in the house at the time, but all escaped unhurt with the exception of one woman who was quite badly injured. A three-ton fragment landed in the yard in the rear of the four-story building at 463 Carroll street and buried itself in the earth to a distance of 10 feet.

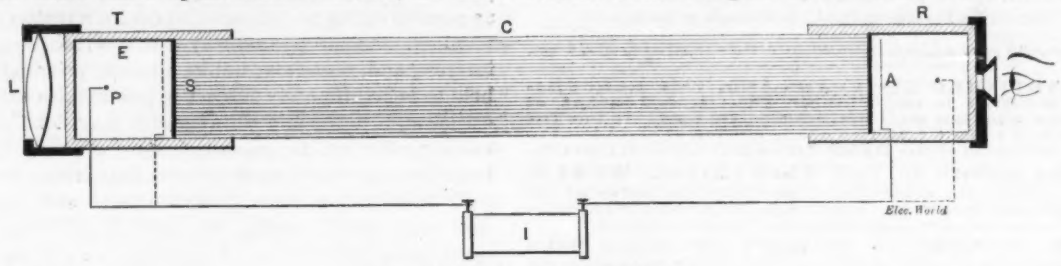
John Deloso, an Italian laborer, of 458 Carroll street, had his right arm broken by being struck by a piece of the wheel. Engineer John Coplis, aged 50 years, of 479 Seventh avenue, was the only person in the building injured. He had just come on duty when the accident occurred, and was scarcely 10 feet from the wheel. He was hurled against the wall, and when picked up was unconscious.

POWER HOUSE AFTER BURSTING OF 20-TON FLYWHEEL.

Seeing by Electricity.

BY GEO. H. MORSE.

The idea of transmitting the image of a moving object to a distance by means of electricity is not a new one. Even before the invention of the telephone, experiments were made upon flexible mirrors, in which mechanical or electrical devices were employed to indent the surface from behind, hoping thus to vary the amount of reflected light, and so form a luminous image.



SEEING BY ELECTRICITY.

The more common idea has been, however, to present different points of the receiving plane successively to the exciting action, making the time of covering the entire surface so short and repetitions so frequent that the human eye should detect no deficiency in any part of the picture thus formed. Since the retention of an image upon the retina does not much exceed one-tenth of a second, and since an unilluminated space equal to 1-225 of a millimetre in diameter would be discernable to the ordinary eye, it is to be remarked that the amount of light coming from any one point in a receiving instrument arranged according to the above plan would be very small, probably too small to be seen no matter from how powerful a source it might be originally obtained. Mechanical as well as electrical difficulties would seem also to offer a negative to this method of successive illumination of all the points in a transmitted picture.

In view of the fact that no actual results have yet been obtained worthy of note, and that all is still conjecture, the present writer ventures to offer a suggestion which occurred to him while observing the manner of testing the vacuum in the incandescent lamps manufactured by one of the large companies. The lamps, after having been exhausted and sealed, are placed near an iduction coil in a dark room. A comparatively bright light is observed within the globe, and if the latter is not too highly exhausted the light seems to gather and play around the filament in a very marked manner.

What would appear to be a practical form of the apparatus here described would require one very thin, well insulated wire leading from every illuminated point in the transmitter to a corresponding point to be illuminated in the receiver. The two instruments would, therefore, be connected by a large cable made up of many thousands of small insulated wires. This arrangement would, in fact, much resemble the scheme of transmission between the retina of the eye and the brain by many thousands of nerve fibres, each one of which is insulated from the rest by a thin tissue.

The transmitter and receiver are to be exactly similar and interchangeable, save that one when used as transmitter is fitted with a lens resembling a camera obscura. In making the instrument, a great number of very fine insulafed wires are first bound tightly together in such a quantity that their combined circular cross section will, when the cable is squarely cut through, form a disc of a size large enough to accomodate the image to be transmitted. This disc formed of the massed ends of the fine wires must now be treated with a coating of selenium, lamp black or other substance whose resistance is reduced by the action of light. The end of the cable, prepared as above, is then to be fitted airtight into the mouth of a short hollow cylinder of glass having a smooth, flat and clear bottom through which the original image may be projected by the lens upon the selenium-treated disc in the transmitter, or by means of which the reproduced image formed in the receiver may be observed. The glass cylinder has all but its bottom covered with some light excluding varnish and is exhausted of air.

A single well insulated wire having its bare extremities in front of the centre, and at some distance from the transmitting and receiving discs, and including in its circuit the secondary of an induction coil, passes airtight through the glass cylinders. The extremities of this wire may, however, be, if found necessary for distribution of the electricity, attached to very fine metallic network lying parallel to and close to the selenium-covered discs.

The arrangement is illustrated in the accompanying cut. T is the transmitter; R the receiver; C is the cable; E the exhausted glass cylinder; S the selenium-covered disc; P a metallic point connected with the secondary of the induction coil I. A shows position of fine wire network, if used in place of point P.

The lens L throws an image upon S thus making the selenium a conductor in variable degrees over the ends of those fine wires which are to transmit lighter parts of the picture. The high potential charge being diffused from the point P, or net A, through the rarefied air, passes along such of the fine wires as are the best conductors, due to the illuminated selenium, and finally emerges at the receiver end of the wires, thus causing a phosphorescent glow to appear there. In this manner the new or transmitted image will be formed.

The Impedance of Mutually Inductive Circuits.

BY A. E. KENNELLY.

In an interesting paper on "Mutual Inductance and Capacity," appearing in No. 2 of "The Physical Review," and recently read before Section A of the Electrical Congress at Chicago, Drs. Bedell and Crehore discuss algebraically the currents flowing in two mutually inductive circuits containing inductance, resistance, and capacity. It is the object of this article to show that such circuits, when conveying harmonic currents, can be treated simply and conveniently by the geometrical methods of impedance.

In the "Transactions of the American Institute of Electrical Engineers" for April, 1893, Vol. X., No. 4, page 173, it is pointed out by the present writer that the distribution of simple harmonic currents in any network of conductors possessing resistance, inductance, and capacity, can be determined by the corresponding rules for continuous currents, if definite "imaginary" resistances be substituted for the condensers and self-inductances. Mutual inductances are, however, left out of consideration, and the omission may here be supplied.

If a circuit a is supplied by an effective alternating E. M. F. of e_a volts with sinusoidal currents making $n = \omega/2\,\pi$ periods per second, and has a "non-ferric" inductance of l_a henrys, a capacity in series of c_a farads, with total resistance of r_a ohms, the impedance J_a of the circuit may be graphically represented by two rectangular components, namely, a horizontal resistance of length r_a and a vertical "*reactance*" of length $s_a = \omega l_a - \dfrac{1}{\omega\, c_a}$, while by Ohm's law the current in the circuit becomes $i_a = e_a / J_a$ ampères.

Now suppose a secondary circuit b of impedance J_b whose components are similarly r_b and s_b to become linked with a through the influence of a mutual inductance of μ henrys.

The first tendency will be for the current i_a in a to set up an induced E. M. F. in b of $\omega\mu\, i_a = e_b$ volts, which would give rise to a current in b of $i_b = e_b / J_b$ ampères. But this current when flowing would act from b as a primary on a as a secondary circuit, and set up in a an induced E. M. F. of $\omega\mu\, i_b$ volts, the current from which would be superposed upon i_a and would in turn react upon the circuit b. These successive modifications in primary and secondary currents would cause them to rapidly converge toward values so adjusted that the current in each circuit obeys Ohm's law after the E. M. F. induced by its neighbor is taken into account. Calling i_A the finally modified or resultant current strength in the primary circuit, i_A would be established by the E. M. F. e_a unaided if the primary impedance J_a were altered to J_A such that $i_A = \dfrac{e_a}{J_A}$. This virtual impedance J_A is obtained from J_a by increasing the resistance component r_a by $n^2\, r_b$, and diminishing the reactance component s_a by $n^2\, s_b$ where n

$= \frac{\omega\mu}{J_b}$. The primary current is thus

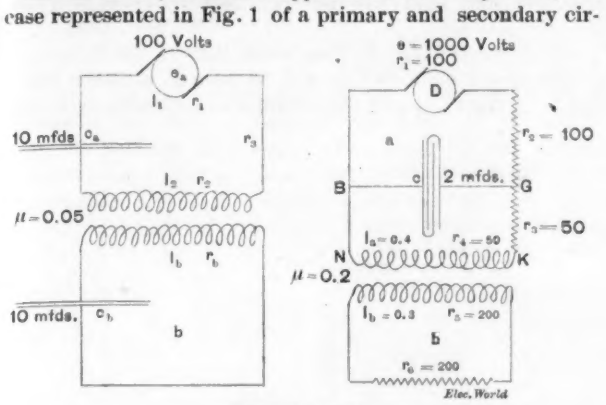
$$i_A = \frac{e_a}{J_A} = \frac{e_a}{\sqrt{(r_a + n^2 r_b)^2 + (\jmath_a - n^2 \jmath_b)}}$$

the induced secondary E. M. F. $e_B = \omega\mu\, i_A$, and the secondary current $i_B = \frac{e_B}{J_b} = \frac{\omega\mu\, i_A}{J_b} = n\, i_A$.

The effect of bringing the circuit b into relation with a is to virtually modify the impedance of a, the primary, and to establish in b the E. M. F. $\omega\mu\, i_A$.

An equivalent to this result was first given by Maxwell.

As an example of the application of this process, the case represented in Fig. 1 of a primary and secondary cir-



FIGS. 1 AND 3.

cuit may be considered. Condensers are inserted in each circuit for the sake of generality, but their removal may be effected when requisite by assuming in the formula that their capacity is infinitely great.

In the primary circuit a let the total resistance $r_a = (r_1 + r_2 + r_3) = 20$ ohms, the capacity $c_a = 10$ microfarads $= 10^{-5}$ farad, the inductance $l_a = (l_1 + l_2) = 0.2$ henry, the effective E. M. F. $e_a = 100$ volts.

In the secondary circuit b let the resistance $r_b = 50$ ohms the capacity $c_b = 10$ microfarads $= 10^{-5}$ farad, the inductance $l_b = 0.05$ henry.

Let the mutual inductance be $\mu = 0.05$ henry and the frequency $n = \omega / 2\pi = 159.15\sim$ so that $a = 1{,}000$.

Then Fig. 2 represents the corresponding impedance dia-

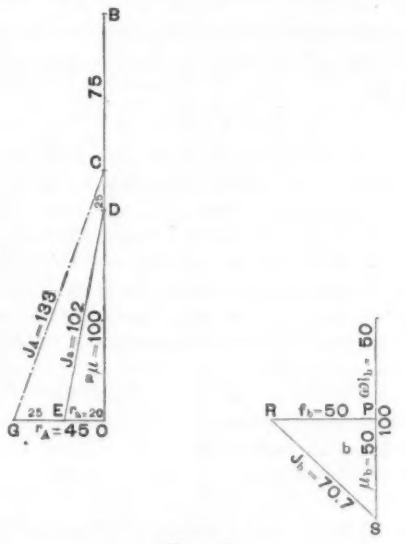


FIG. 2.

grams for the primary and secondary circuit. $O\,E = 20$ ohms, $O\,B$ is the primary inductance-speed $\omega l_a = 200$, $B\,D$ the capacity-speed-reciprocal $1 / \omega\, c_a = 100$, laid off downward, so that $E\,D$ gives the primary normal impedance $J_a = 102$ ohms. Similarly $S\,R$ represents the secondary impedance $J_b = 70.7$ ohms, the reactance $\jmath_b$ being here negative, by reason of the excess of capacity-speed-reciprocal over inductance-speed. The factor n^2 is now $\left(\frac{\omega\mu}{J_b}\right)^2 = \left(\frac{1000 \times 0.05}{70.7}\right)^2 = 0.5$, so that according to rule the primary resistance is increased by $n^2\, r_b = r_b/2 = 25$ to G. Half the secondary reactance is now deducted from the primary reactance, but since $\jmath_b$ is negative, $-\, n^2\, \jmath_b$ is positive, and the primary virtual reactance is increased to $O\,C = 125$. $G\,C$ therefore represents the virtual impedance $J_A = 133$ of the primary circuit, in which the current will be $i_A = \frac{e_a}{J_A}; \frac{100}{133} = 0.752$ ampère, whence the secondary E. M. F. will be $\omega\mu\, i_A = 37.6$ volts and the secondary current $e_B / J_b = \frac{37.6}{70.7} = 0.532$ ampère.

We have hitherto considered that before bringing the two circuits a and b into mutual influence, a only contained E. M. F. and current, b being inactive. The same treatment can, however, be readily extended to cases in which both circuits are separately active and contain independent E. M forces. It is only necessary to determine the distribution for each circuit in turn as though the other had no independent E. M. F., and then find the vector sum of these two current distributions. The sum will be the resultant current system when both circuits are independently active and each acts both as primary and as secondary to its neighbor.

To illustrate the ready application of this method to more complex cases, one more example may be permitted.

Fig. 3 represents a simple harmonic E. M. F. acting upon the primary circuit of an induction coil shunted by a condenser. The secondary circuit of the coil is closed through a resistance. In order to determine by the ordinary algebraical process the currents and voltages in the various branches of this system, a determinant of the sixth order would have to be solved. By the graphic methods of impedance treatment the solution is readily obtained, and a check is kept upon the arithmetical work, even if the diagrams are subordinated as mere guides to their equivalent numerical operations. The first step is to find the impedance of the secondary circuit, then to modify the impedance of the primary branch $B\,N\,K\,G$ for the mutual inductive effect; next to find the joint impedance of the modified primary branch and the condenser in parallel, and finally to sum this joint impedance with that of the main branch $B\,D\,G$ for the total effective impedance of the main circuit. This divided into the effective E. M. F. gives the main current by Ohm's law, and the various branch current strengths immediately follow.

Let $e = 1{,}000$ volts effective, at $\omega = 1{,}000$ or $n = 159.1\sim$
Let $r_1 + r_2 = 200$ ohms,
Let $r_3 + r_4 = 100$ ohms,
Let $r_5 + r_6 = 400$ ohms,
Let $l_a = 0.4$ henry $\therefore\ \omega\, l_a = 400$,
Let $l_b = 0.3$ henry $\therefore\ \omega\, l_b = 300$,
Let $\mu = 0.2$ henry $\therefore\ \omega\, \mu = 200$,
Let $c = 2$ microfarads $\therefore\ 1 / \omega c = 500$.
Then diagram b of Fig. 4 represents the impedance of

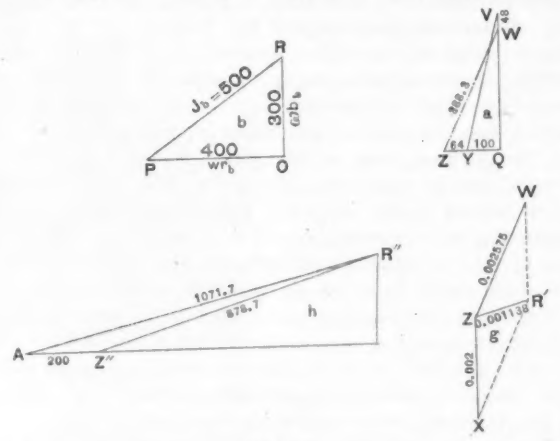


FIG. 4.

the secondary circuit, $O\,P$ being the resistance of 400 ohms to scale, $O\,R$ the resistance of 300 ohms and $P\,R$ the impedance J_b of 500 ohms. The factor of mutual influence $\left(\frac{\omega\mu}{J_b}\right)^2 = 0.16$, so that the increments to the primary branch components are $0.16\, r_b = 64$ ohms, and $-\,0.16\, \omega\, l_b = -\,48$ ohms. Diagram a shows the impedance of the primary branch $B\,N\,K\,G$ and its modification under mutual inductive effect from $Y\,V$ to $Z\,W = 388.3$ ohms. Diagram g shows the vector sum $Z'\,R'$, of the vector reciprocals of $Z\,W$ and of the condenser impedance, to a conveniently altered scale, while the reciprocal of $Z'\,R'$ is $Z''\,R''$ in diagram h, $= 878.7$ ohms to the original scale.

This is the impedance of condenser and coil in parallel. The impedance ($r = 200$ ohms) of the branch $B\,D\,G$ is now added vectorially in diagram h, bringing the impedance of the main circuit to $A\,R'' = 1{,}071.7$ ohms.

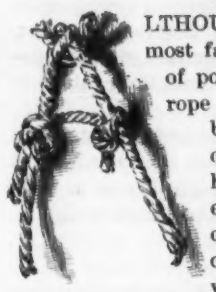
The main current in $B\,D\,G$ will therefore be $\frac{1000}{1071.7}$ $= 0.9330$ ampère. The drop in $B\,D\,G$ will be 0.9330×200 $= 186.60$ volts. The effective voltage between points B and $G = 813.4$. The impedance of the condenser is 500 ohms, so that its effective current is $8134. / 500 = 1.627$ amperes. The effective impedance of the modified primary coil branch $B\,N\,K\,G$ is 388.3, and the current it receives $813.4 / 388.3 = 2.1$ amperes. The E. M. F. in the secondary circuit is this current multiplied by $\omega\mu$, or 420 volts, and the current strength in the secondary circuit is consequently $420 / 500 = 0.84$ ampère.

A current of less than one ampère in the supply circuit thus supports a current in the primary of the coil of more than two ampères with the assistance of the condenser situated at what may be regarded as the receiving end of the line.

By this method any network of circuits containing resistances, capacities and self or mutual inductances under the operation of simple harmonic E. M. Fs. can be treated up to any reasonable degree of complexity with little difficulty, when the corresponding direct algebraical process would be prohibitively laborious. If the E. M. Fs. may not be regarded as sinusoidal, it may be possible to analyze them into sinusoidal components, to then treat these separately and afterward sum their resulting currents geometrically. The phase of each current can be readily found from the impedance diagrams. Hysteresis in the induction coils and condensers is for the present ignored, which will no doubt limit to a great extent the practical application of the system, but it is at least of some advantage to possess a method which brings harmonic current circuits almost on a par in simplicity with continuous current circuits, and under the direct application of Ohm's law, even if the secondary influences of iron have to be at present omitted or left for secondary consideration.

Rope Driving.

BY J. J. FLATHER.



ALTHOUGH toothed gearing and belts are the most familiar mediums for the transmission of power in mills and factories, systems of rope transmission for this purpose have been in use for many years, but it is only within the last ten years that they have given promise of being more generally recognized in this country as a convenient and efficient means of accomplishing the ends for which they were designed. Until about fifty years ago it was generally thought by engineers that cotton and woolen mills, and all others requiring a considerable amount of power, could not be run effectively without large and ponderous lines of upright and horizontal shafts of either cast or wrought iron and heavy trains of gear wheels.

When large leather belts began to be introduced as a substitute for gears it was thought to be an experiment of very doubtful result, if not altogether impracticable;* but when high speeds and lighter shafting were used in conjunction with the wide belts, the marked success which attended their general adoption in America during the next twenty years attracted considerable attention in England; it was not, however, until about thirty years ago that the American system began to replace the old fashioned gearing. The belt system made very slow progress in England, however, and before it had been at all extensively adopted, a newer method was introduced and quickly came into prominence, making such rapid progress as to almost entirely supplant the old wheels. The use of hemp rope for power transmission had been revived about 1860 by the Messrs. Combe & Barbour, of Belfast, who introduced it successfully into small mills in the north of Ireland. This was followed by its speedy adoption in the jute mills of Dundee, and subsequently in the cotton mills of England.

By this system according to one of its earlier promoters,† Mr. Jas. Durie, large powers were transmitted "by means of round ropes working on grooved wheels, which in some parts of this country (England) have been largely substituted for toothed gearing. In this mode of driving, the flywheel of the engine is made considerably broader than the flywheel of an engine having cogs on its circumference; and, instead of cogs, a number of parallel grooves for the ropes are turned out, the number and size of which are regulated by the power to be taken off the flywheel. The power which each of the ropes will transmit depends upon their size and the velocity of the periphery of the flywheel."

As rope driving has, until recent years, been a matter largely of experiment, the results which have been obtained from its use have not always been of uniform excellence, mainly, however, because designers have failed to properly recognize the requirements.

As the conditions under which the systems were installed have been so varied, it is not surprising to find many cases where the ropes have been rapidly worn out and replaced by leather belting, or other systems of transmission; but where rope driving has been tried and has failed, investigation will invariably show the absence of suitable conditions or a disregard of correct principles of design or construction. In many applications too great a strain is put upon the rope, and the stretch and wear are rapid; in addition to this the pulleys are often of unsuitable size, and the rope is unnecessarily weakened through the action of the fibres upon one another. Both of these causes are a constant source of annoyance in a rope drive which has been poorly designed or constructed. A case in point can be shown not far from Chicago, where a rope would stretch to such an extent that it had to be taken up every few days when new, and later every two or three weeks—a rope under these conditions lasting less than four months. Investigation showed that a tension weight of 600 pounds had been placed upon the rope, which was of ¾ inch diameter. A weight of 50 pounds was substituted and the rope has since been running satisfactorily for three years, and has only been taken up once in that time.

Cases where ropes have suddenly broken are few in number, the risk in this respect being reduced to a minimum by the fact that any defect in a rope, arising either from wear or other cause, will show itself long before the point of danger is reached.

The ropes by which the power is transmitted consist of an elastic substance, and their lightness, elasticity and comparative slackness between the pulleys are highly conducive to their taking up any irregularity that may occur in the motive power.

Their quiet working and convenience in application, much more so than wide belts, are also features which caused ropes to be looked upon with great favor. Another reason for its rapid progress in England, which was considered a great advantage by the millowners, was the adoption of the multiple rope—now known as the English —system in which a number of single ropes is spliced and run side by side.

The entire freedom from any risk of a break-down or stoppage of the works which might occur with gearing was an important factor in replacing the latter by the newer system; the working stress in the ropes being but a friction of their breaking strength, any signs of weakness in an individual rope would allow it to be removed and the engine

*"Journal Franklin Inst.," 1837.
†"Iron," London, Oct. 28, 1876.

run with the remaining ropes until a convenient opportunity offered for the replacement of the weak member.

One of the great advantages of rope driving over gearing lies in the steady motion produced, but this has been attributed more to an accidental combination of heavy flywheel and high velocity than to any inherent advantage in the system itself.

In spur gears diameters of 20 to 24 feet were usual in large engines, while for ropes, the pulleys are 25 to 35 feet n diameter; and, whereas the gears weighed from 20 to 25 tons we find rope pulleys used for the same work weighing from 60 to 75 tons.*

When we consider the speed at which these heavy wheels are run—from 3,000 to 6,000 feet per minute—it is not surprising that uniform rotation is obtained; and whether it be that the energy stored in the moving mass prevents fluctuation, or whether the elasticity and other properties of the rope perform the same office, or—which is more reasonably the case—all of these factors act together, the truth remains that steadier running and a greater output are now obtained with rope driving than was formerly the case with toothed gearing.

The general experience is not altogether in favor of ropes, for, while the advantages of smooth running and easy handling are conceded, it is also acknowledged that the extra weight and greater width of pulleys increase the journal friction over that found with toothed gearing, and that otherwise a greater loss of power occurs, the causes of which will be discussed subsequently.

It is difficult, however, to determine the relation between the power absorbed by ropes and gears, for in nearly all cases where rope driving has been substituted for gears, other changes have been made at the same time, or the engines were, after the alteration, driven at an increased speed, so that there has been little opportunity for comparison. There is, however, a generally accepted opinion among engineers that the loss in rope transmission is from 5 to 10 per cent. greater than with gearing.

Mr. A. G. Brown† states that in the older cotton mills of England, where the main drives are by gearing, and belting is used for the intermediate and machine driving, the friction of the engine, shafting, gearing and belting averages about 20 per cent. of the whole power, the engine developing at full loads from 500 to 800 i. h. p.

These engines were compound condensing, and consisted in each case of an overhead beam engine, which had been converted into a compound by the addition of a high pressure cylinder between the crank and beam centre.

In the newer mills, for doing practically the same work, and where the main and some of the intermediate drives are by ropes, the friction of the engine, ropes, shafting and belting averages 23 to 25 per cent. of the whole power, the engines developing from 800 to 150 i. h. p. It is fair to assume that the newer engines have at least no greater percentage of friction than the older ones, except that due to an increased journal friction attributable to the larger journals and greater weight of the rope pulleys; also the friction of the intermediate shafting and small belts should be the same in each case; therefore it is reasonable to conclude that the increase of power absorbed by the use of rope driving is chargeable to the system itself. The writer has assumed in similar cases that the loss at the engine in rope driving is about 10 per cent. of the indicated horse power, that an additional 10 per cent. is absorbed by the mill shafting, and that from 5 to 8 per cent. may be attributed to losses in the rope itself due to resistance to bending, wedging in the grooves, differential driving effect, and creep, all of which affect the loss, to a greater or less extent. As compared with the above, the friction of shafting and engines in American cotton mills, where belting is used exclusively, shows that the loss where large belts are employed is somewhat less than that obtained with ropes in the English mills.

Mr. J. T. Henthorn, in a paper read before the American Society of Mechanical Engineers, states that the friction of the shafting and engine in a print mill should not exceed 19 per cent. of the full power; but out of 55 examples of a miscellaneous character which he has tabulated only seven cases are below 20 per cent., 20 vary from 20 to 25 per cent., 15 from 25 to 30 per cent., 11 from 30 to 35 per cent. and two above 35 per cent. We note that the greater number lies between 20 and 25 per cent.; allowing a variation of 5 per cent. each side of these limits we shall obtain values from which a fair average may be determined. This will include those cases under 20 per cent., but not those over 30, from which we find the mean loss to be 23.9 per cent. of the total power.

Mr. Barrus, speaking of this subject, quotes eight cases, the data of which were obtained from tests made by himself in various New England cotton mills, in which the minimum percentage was 18 and the maximum 25.7, the total average being 22 per cent.

Mr. Samuel Webber states that 16 per cent. of the total power of a mill is sufficient to overcome the friction of shafting and engine—10 per cent. for the shafting and 6 per cent. for the engine. But in this estimate Mr. Webber does not include the loss due to the belts running upon loose pulleys, which he does not consider to be part of the shafting, as they are not so running while the machinery is in operation; and when it is not, they may be thrown off as well as not, except for convenience.

He further estimates, both from his own experience and the observations of others, that the power consumed by the machine belts on the loose pulleys in a large cotton mill is about eight per cent. of the whole. This eight per cent. added to the 16 per cent. loss due to shafting and engine will give 24 per cent. of the total power—a result which agrees closely with the average values given above.*

Considering the greater loss which occurs in the use of ropes and belts for main drives, the recent revival of gearing for this purpose has much in its favor. The advantages of rope transmission for main drives in large plants would not be as apparent if compared with modern gearing. The kind of gear used for this purpose to-day is not the rough cast gear used formerly, whose uneven motion produced a rumbling which could be heard a mile or two from the mill. The present gears are machine cut, made to bear equally on each tooth, and with a contact across the whole face of the gear, causing little more noise than the ropes.

With greater speed and stronger and heavier gears steady running is insured, and by using properly proportioned machine cut teeth comparatively little noise results. The saving of space is also an important factor advanced in favor of gearing. At the present time steel gears 30 feet in diameter are being made, with all the teeth cut, for transmitting the powers of mill engines in the Oldham district,† while in this country machine cut gears from 30 to 50 feet in diameter are in use.

Where ropes have been used to replace gearing in the English mills the plan adopted has been to put in a new grooved flywheel, or to place grooved segments upon the existing flywheel, when the speed could be increased sufficiently to allow of a limited number of ropes being employed, and the width of the wheel pit was also sufficient for the purpose; but if this plan could not be adopted grooved pulleys were put on the intermediate shaft, and the ropes carried to the different stories of the mill. It has sometimes been necessary to put in a countershaft, so as to gain speed and obtain a sufficient distance between the centres of the shafts on which the pulleys are placed.

Where rope driving has been installed in new factories special provision has been made for the ropes, and we find in such cases rope wells or chambers built in, suitably fitted with platforms and staircases to give access to the pulleys on the various intermediate shafts and their bearings.

The majority of drives are arranged so that the ropes are inclined rather than vertical, and with the driving or tight side of the rope on the lower side of the pulleys; then when transmitting power, the two sides approach each other, and the arc of contact is increased.

An additional advantage is that obtained by the weight of the rope acting on both pulleys, thus allowing a low initial tension to be maintained. This does not hold for short distances between centres, as under such conditions the weight of the rope adds little to the total tension; on the other hand, where the distance between the pulleys in vertical drives is small, the relative weight of the rope being small as compared with its tension, there will be little tendency for the rope to leave the bottom sheave.

With these conditions the efficiency of vertical drives will approach that of a horizontal or inclined arrangement of ropes.

(To be continued.)

Design of Alternating Current Motors.—II.‡

BY EMIL KOLBEN.

III. Determination of the Magnetism Current and the Load Current.—The well known method of finding the idle current of a transformer applies equally well to motors also. If y, y_1, y_2 (Fig. 4) are the means lengths of the magnetic circuits and B, B_1 and B_2 the $\sqrt{\text{mean}^2}$ values of the induction densities in the field, the air gap and the armature H and H_2 the corresponding values of the magnetizing forces, then the total number of ampere turns required on the field of a motor of $2p$ poles at no load will be:

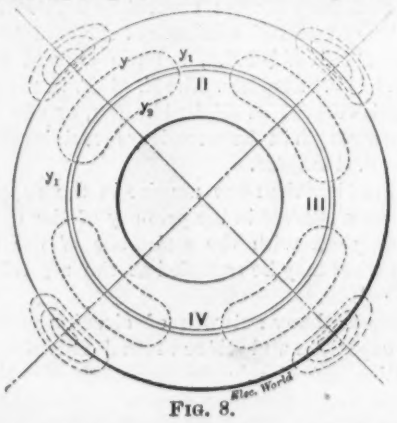


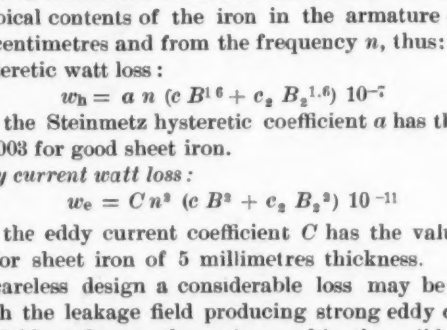
FIG. 8.

$$i N = \frac{10}{4\pi} 2p\,(2 y_1 B_1 + Hy + H_2 y_2),$$ hence, the $\sqrt{\text{mean}^2}$ value of the magnetizing current

$$\bar{i} = \frac{1.59\,p\,(2y_1 B_1 + Hy + H_2 y_2)}{N} \qquad (16)$$

We see at once that i will reach a high value if high frequencies (such, for example, as used generally in American practice) are employed, for then the number of pairs of poles must at least have the value of $p = 5$, in order to come down to reasonable speeds. The chief factor, of course, is the air gap reluctance, and as the gap is, from mechanical reasons, the same for a certain size of motor, whether it is run on high or low frequency circuits, the magnetizing current will increase with the number of poles and consequently with the frequency.

The idle current, or the current which the motor takes when it is running free, will be but little different from the magnetizing current, as the actual work of w watts performed by the motor due to friction and copper losses in armature and field will be very small. If $i_1 = \frac{W}{E}$ is $\sqrt{\text{mean}^2}$ current due to this work, then $i_2 = \sqrt{i^2 + i_1^2}$ is very closely equal to i, as will be seen at a glance from Fig. 7. If the value of i_2 should differ considerably from the



FIGS. 9 AND 10.

calculated magnetizing current, then the design of the motor is faulty, for then there must be false currents induced in the armature conductors, which become a source of loss of energy, and by this the value of i_1 and with it that of i_2 will increase largely. This fact will be also at once evidenced by a considerable slip even at no load.* The full load current I can now be found in the following manner: The magnetizing current at full load, although somewhat smaller than at no load, on account of the reduced induction densities in the iron, may be taken equal to i without an appreciable error. The useful energy delivered by the motor is W watts and w_1 the energy due to copper and friction losses; from these we find the *true working current* at load:

$$I = \frac{W_1 + w_1}{E}$$

and the actual current will result from the combination of I and $\bar{i}$ according to diagram, Fig. 8, and its $\sqrt{\text{mean}^2}$ value will be.

$$I = \sqrt{I^2 + i^2} \qquad (17)$$

With this value the section of the field wire and the copper losses in it should be accurately verified.

IV. Motor Efficiency.—The total efficiency may now be found exactly by calculating the following losses:

(1) The *hysteretic loss* w_h and eddy current loss w_e from the known maximum induction densities B and B_2 from the cubical contents of the iron in the armature c and c_2 cubic centimetres and from the frequency n, thus:

Hysteretic watt loss:

$$w_h = a\,n\,(c\,B^{1.6} + c_2\,B_2^{1.6})\,10^{-7}$$

where the Steinmetz hysteretic coefficient a has the value $a = 0.003$ for good sheet iron.

Eddy current watt loss:

$$w_e = C n^2\,(c\,B^2 + c_2\,B_2^2)\,10^{-11}$$

where the eddy current coefficient C has the value $C = 0.004$ for sheet iron of 5 millimetres thickness.

By careless design a considerable loss may be caused through the leakage field producing strong eddy currents in the field conductors themselves and in the solid iron or metal frame holding the iron discs together.

(2) The *copper loss in the field* from the full load current I (see equation 17), and the resistance of the field winding R:

$$w = I^2 R.$$

(3) The *copper loss in the armature* from equation (10):

$$w_1 = u\,\frac{E_1^2}{R}$$

(4) *Friction losses* due to the bearings and the air resistance at full speed to be easily estimated or taken from tables of mechanical text books.

Fig. 9 gives an idea of the variations of the total motor

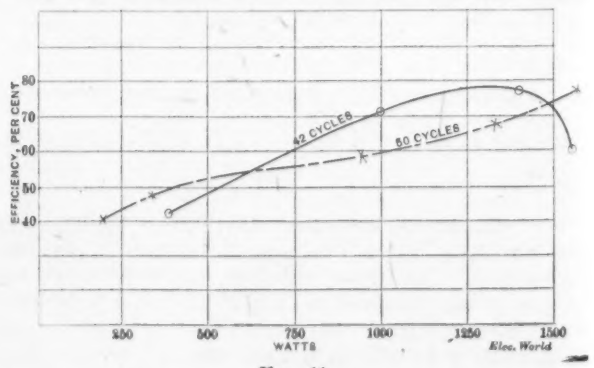


FIG. 11.

efficiency with the output. The two curves are plotted from results of test on an Oerlikon 2-h. p. single phase motor designed to work on a circuit of 42 cycles.

As an example of heavy flywheel for rope driving weighing 140 tons, 30 feet in diameter, 15 feet face, grooved for 60 ropes, to transmit 4,000 h. p., see "Engineer," January, 1884.

Another example of heavy rope wheels are the four pulleys recently made by the Walker Manufacturing Company, of Cleveland, for the Broadway Cable Company, New York, 32 feet in diameter, grooved for thirty-four 2-inch ropes, and weighing 104 tons each.

† "American Machinist," July 21, 1888.

* See the writer's "Dynamometers and the Measurement of Power."

† Richards' "Mechanical Progress," 1891.

‡ For the first section of this article see THE ELECTRICAL WORLD, Oct. 14, p. 284.

* These false currents are inevitable with single phase motors, as the field strength is fluctuating. With three phase motors the field is entirely homogeneous and false currents are thus obviated.

The Electrical Features of Milwaukee.—II.

NEAR Oneida street, located on the Milwaukee River, is one of the two generating plants of the Milwaukee Street Railway Company, known as the Edison Light and Power Station, the other being a temporary power plant on the south side, near the Kinickinick car barns, described above. In the former there is exemplified that plan so often advocated, but, strange to say, so little practiced, of the consolidation of the electric railroad and lighting interests.

The building is a very substantial, if not architecturally handsome, brick structure, 100 feet front by 105 feet deep and 60 feet high. Upon the top floor are located the coal bins, which are filled from the street in front or the river in the rear by means of conveyers operated by a No. 9 Edison street railway motor. From these bins the fuel descends to the boilers in the basement by gravity, thus doing away entirely with its further handling. The ashes resulting from the combustion of the coal are also handled by conveyers.

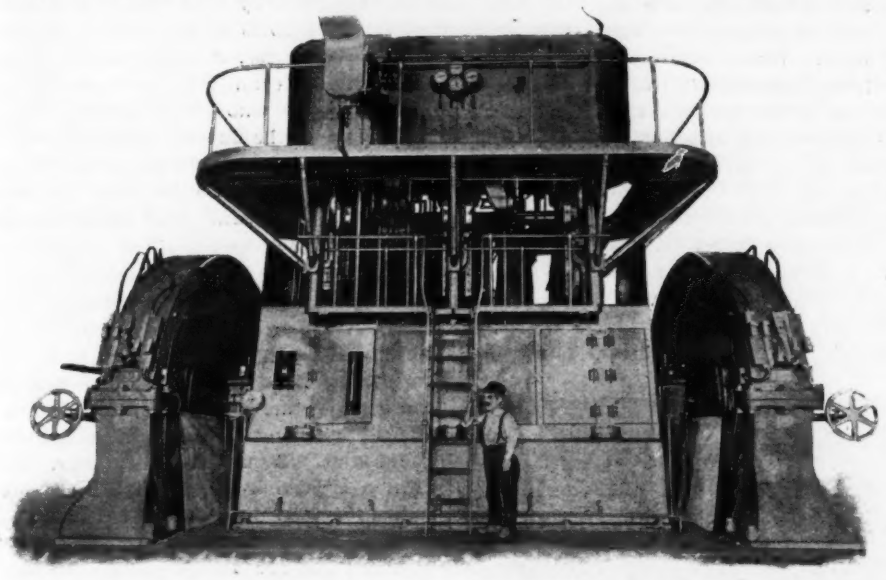


FIG. 7.—DOUBLE 200 K. W. ELECTRIC RAILWAY GENERATOR.

Upon the top floor is located the lighting plant, which consists of three double 100-kw. multipolar direct-connected generators and one double 50-kw. generator of the same type. All these generators have eight poles (except the smaller one, which has six) and eight brushes. The brush holders are attached to a brush spider supported by a three-legged spider frame and are moved simultaneously by means of a tangent screw. The commutators of all the armatures are the bared windings at the end of the armature—a style which is now much used by the General Electric Company, who, by the way, equipped this plant throughout. All of the generators are driven by triple-expansion marine engines. Fig. 6 gives an excellent view of this plant, which now has connected up some 10,000 lights. At the east end of the floor (not shown in the cut) is the marble switchboard by which the various circuits and the generators are controlled. This is raised some eight feet from the floor, and is approached by a short stairway leading to a light gallery.

The apparatus thus far described occupies only about half of this floor. The other half—the north half—is already fitted with steam and exhaust piping suitable for 13 more double 100-kw. generators, so that, it will be observed, ample provision for the future has been made. At present they have in temporary use on this floor a McIntosh & Seymour engine belted to a No. 60 Edison dynamo, which has been used on the railway circuits while some new generators were being installed in the railway plant on the floor below. There are also on this same floor two smaller dynamos (Edison No. 6) used to run the night lights of the station.

THE POWER PLANT.

On the ground floor is located the railway power plant, which consists of five double 200-kw. generators of the General Electric Company's make. There are six poles to each armature, and the latter are directly connected in pairs to large marine engines. Fig 7 shows one of these engines, with its two generators, and an idea of its size may be gained by comparison with the figure standing in the foreground. On the wall to the right is the great switchboard of white marble, which is 72 feet long by 10 feet high.

Directly south of the dynamo room is the boiler house. This is divided into two floors, upon each of which is a bank of nine Gallaway boilers of 250 h. p. each.

In the basement are located the condensers, which are Wheeler surface condensers, one for each engine; four Knowles air pumps and four Knowles duplex circulating pumps. The condensers for the lighting plant are also located here—also the air and circulating pumps. These are of the same makes as those used for the power plant—two each of the condensers, air and circulating pumps being employed for the purpose.

Mr. O. M. Rau is the electrician in charge, and to his skill and efficiency much of the success of this large station is due. It is seldom that so great responsibilities are intrusted to such young shoulders, but it is seldom that they are so skillfully managed as he has managed them. Mr. Rau, besides being a skilled electrician, is also quite a skilled photographer, as Fig. 7, which is from a photograph made by him, amply testify.

Mr. Rau informs us that in the Milwaukee Street Railway system there are 21 feeders in all, varying in size from 100,000 circular mils to 700,000 circular mills. The longest of these is seven miles, and has a cross sectional area of 700,000 circular mils.

THE TEMPORARY POWER PLANT.

Immediately after the fire which destroyed the Kinickinick station on Dec. 28, 1892, a temporary power plant was established in the immediate vicinity, and this is still doing duty for the south side. In this there have been installed three Corliss engines; one of 400 h. p., a Geo. H. Corliss; and, one of 300 and one of 250 h. p., both Reynolds-Corliss engines.

These drive, by means of the Chicago Belting Company's belts, two 100-kw. and four 200-kw. General Electric Company Edison bipolar generators.

The boiler plant consists of six boilers—four tubulars, one marine and one patent upright Reynolds boiler. Four of these are in constant operation, and one is kept in reserve.

As a temporary power plant this answers very well, and will be kept in commission for the present.

The electrical equipment throughout, both of the rolling stock and of the power stations, was furnished by the General Electric Company, and at the time it was furnished was considered by them their banner equipment.

At first, as a matter of experiment, cars were bought from nearly all of the principal builders in the country, and before the fire it was said that this road presented the largest aggregation of different makes of cars to be found in operation anywhere. Since the fire the road has been almost entirely equipped anew, and the McGuire & Brill trucks are now numerous. There are at present about 117 open motor cars and 127 box cars in the equipment, with new ones almost constantly arriving. The last order, which has not yet been completely filled, was for 75 open Brill cars and 25 open Pullman cars.

One feature of the equipment will surprise many of the visitors from other cities, viz., the absence of the use of trail cars. Only on special occasions are trains made up, and these usually consist, besides the motor car, of a single small antiquated horse car, which looks as though it had seen its best days, and probably has. But, practically, the company numbers no trail cars in its present equipment.

The motors used are the Edison No. 8, 15-h. p., double reduction; the Edison No. 14, 15-h. p., single reduction; the T.-H. No. 20, 20-h. p., single reduction W. P. On the Becker line, the original storage equipment, 26 motors in all, is still retained throughout, and on the Hinsey line, T.-H. motors to the number of 12 are used, and upon the other lines the different types are used indiscriminately. Most of the cars have 16 or 18-foot car bodies, but on the National avenue line a number of very long cars have been placed in service. These have 34-foot car bodies, and were made by the Gilbert Manufacturing Company, of Troy, N. Y. They are fitted with Bemis trucks and have eight wheels. Two No. 14, 15-h. p. Edison motors furnish the motive power. The seating capacity of these cars is 60. Another noteworthy departure from the usual equipment is the

PALACE DIRECTORS' CAR.

Everybody in Milwaukee knows car No. 200, Fig. 8, for that is its number, as it creates a sensation wherever it goes. This elegant car was built entirely in the shops of the Milwaukee Street Railway Company, and is one of the handsomest specimens of street car construction that can be found anywhere. This is true both of the interior and of the vestibules. The drapery and carpet are of old gold, and the seats, 12 in number, are handsome wicker chairs upholstered in plush to match the drapery. At night it is brilliantly illuminated with ten lamps set in opal globes and shades. At both ends are large mirrors, extending from the roof to the floor. It is equipped with two 15-h. p. Sprague motors on a McGuire truck.

The directors have not been entirely selfish in the use of this car, for they also allow the public to enjoy it. We have spoken of Milwaukee as a Teutonic city. One of the reasons for so styling it is the presence within its bounds of a most admirably conducted German beer-garden, known all over this country as Schlitz's Park. During the summer months light opera is given here in the evening, and it is one of the fashionable divertisements in Milwaukee society to attend these. The directors' car is furnished to parties attending these operas or the theatre at the nominal charge of $8 per evening, and when such parties are given with this accompaniment—the directors' private car—they are considered swell, indeed.

On the occasion of one of the visits of your correspondent to Milwaukee this car was most kindly placed at his disposal, and, under the efficient chaperonage of Supt. Geo. W. Hommell and Mr. Whitney, of the main office, he was given an opportunity of inspecting the lines and equipment, the various car barns, and taking two very delightful suburban rides. One of these was to the charming village of Wawautosa, some four miles to the west, to reach which the cars pass for a distance over the company's own right of way, and thence through country lanes, and finally descend into the valley of the Menominee River, upon which the beautiful village is located. Much of this suburban route is, as before stated, over its own right of way, and on this part of it a light T rail and wooden pole and span wire construction is employed. The country traversed is beautifully rolling and capable of the highest development in the hands of the landscape gardener, and although not yet much settled, shows signs of great activity in that direction, as the farm lands have already been plotted, and beautiful driveways are already marked out and some of them partly completed. Already, too, a few pretentious structures are under way, and the next few years bid fair to see the more de-

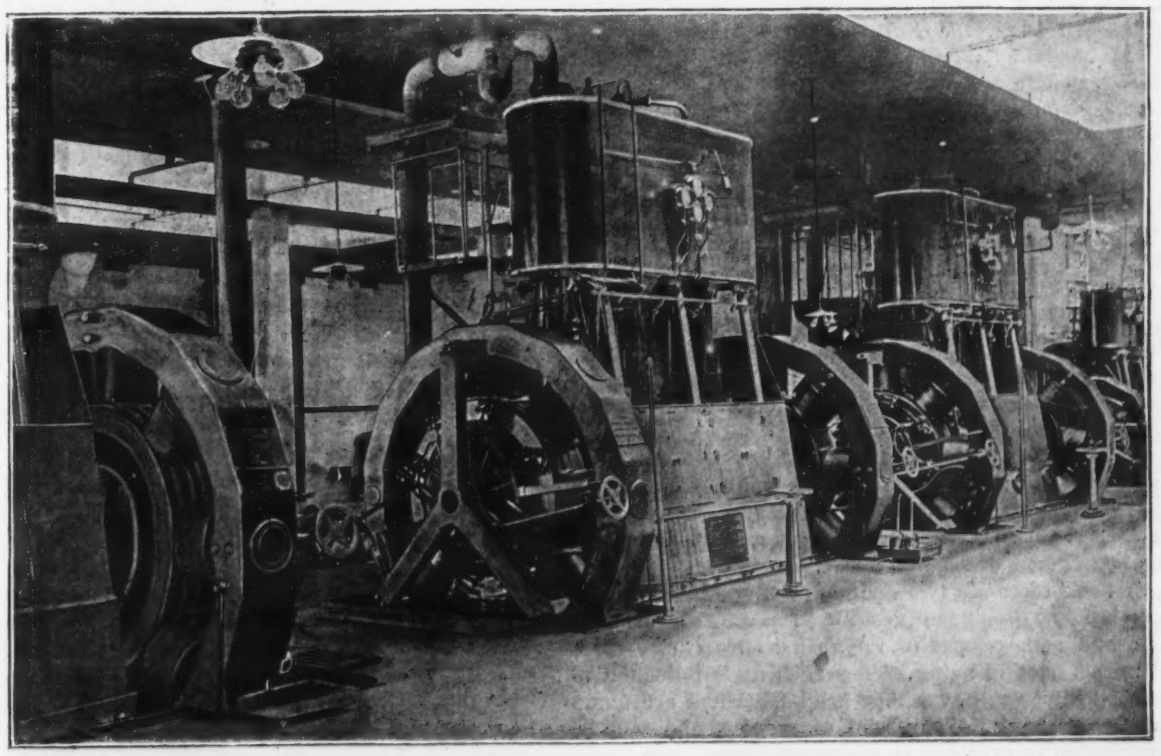


FIG. 6.—INTERIOR VIEW OF EDISON LIGHT AND POWER PLANT.

sirable sites occupied by pretty country villas. The enterprising German, always on the lookout for suitable sites for his own and his countrymen's amusement, has also been pioneer in this district, as one is forcibly reminded at one point by a glaring sign in gaudy red letters on white cotton, which reads:

NEUMILLER'S PARK.
2 BLOKS NORTH J. FISCHBACK.

Wawautosa is already the home of many of the wealthy Milwaukeeans, and, as before stated, is a beautiful village. It is located on the Menominee River, and is also reached by the Chicago, Milwaukee & St. Paul Railway, but the pleasantest method of approach is by the electric line, which, after passing from its own right of way, turns down one of the most romantic little country lanes imaginable. After traversing this for a considerable distance amid fine groves of native trees, the track takes a turn to the right, and the village comes suddenly into view. From the depths of the forest, as it were, one is suddenly ushered into the midst of refinement and culture. One is sure of the latter, for right before his eyes stands the loveliest bit of architecture one cares to see. This is the Harwood Library Building, which is Gothic in style, in keeping with the noble elms from beneath the arches of which the car has just emerged. The grounds which surround the library are ample and kept in the very pink of condition, and the well kept lawns and handsome homes in the distance present the raison d'etre, if one were needed, for the little library building which stands, an outpost, as it were, to this secluded home of refinement.

Another enjoyable ride is on the National avenue line, which, besides passing the National Avenue Car Barns and the National Park, leads out to the National Soldiers' Home. This benificent institution has in the neighborhood of 2,000 inmates, and is surrounded by a magnificent park, thickly timbered and beautifully laid out in winding drives and dotted with little lakes. Here during the summer afternoons the most enjoyable concerts are given by the military band among the groves, and these form one of the most attractive divertisements during the heated term, for rich and poor alike. The National avenue line of the Milwaukee street railway runs right into the grounds, and the company has erected a very tasteful building here for a terminal station.

In Milwaukee one looks in vain for evidences of attempts to induce traffic on the electric lines, such as are so largely resorted to in some other cities whose railway systems we have described. Parks there are in plenty—vide the Soldiers' Home, Schlitz Park, the National Park, the Schuetzen Park, the North Street Bridge Park, Neumiller's Park, Juneau Park, and others. These are all reached by the electric system, and all of them undoubtedly assist that system in paying dividends, but none of them were created by the company for that purpose. The Milwaukee Street Railway Company have, however, in a most admirable manner, met the wants of the public by furnishing accommodations to already existing parks, and have thus induced traffic which inferior accommodations would have failed to give rise to. And this excellence of accommodation has encouraged the creation by private means of other resorts along its lines, so that sites so far distant as "2 Bloks North" have been deemed desirable ones for resorts of this kind.

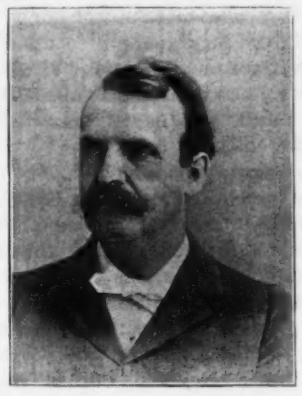
The officers of this company are as follows: Vice-president and general manager, Henry C. Payne; general superintendent, George W. Hommell; assistant treasurer, Geo. O. Wheatcroft; auditor, Wm. L. Mason; superintendent of repairs, A. W. Lynn.

Of these there are two gentlemen whose individuality has been so prominently stamped upon the construction and management of the road as to require more than this passing notice. They need no introduction to street railway men, for they are known and are found wherever street railway men congregate, and will be very much in evidence at the coming convention.

MR. HENRY C. PAYNE.

Mr. Henry C. Payne, an excellent portrait of whom we present herewith, was born in Ashfield, Franklin County, Mass., on Nov. 23, 1843, and hence when the convention assembles will lack but a few weeks of being 50 years of age. His early education was that of the business man rather than that of the scholar, though his attainments are scholarly, and there are few men in Milwaukee who surpass him in the graces attributable to the most liberal education. His triumphs, however, have been among men rather than among letters.

In 1863, when 20 years of age, he first came to Milwaukee, since which time his name has been more prominently identified with the material progress of the city than perhaps that of any other one man. As a railroad man, he has long been connected with the Northern Pacific R. R., and the confidence reposed in his judgment and ability has only recently been signally emphasized by his appointment as one of the receivers of that company when it got into financial difficulties. The Henry Villard syndicate had already shown their appreciation of his abilities by placing him at the head of their varied interests in and around Milwaukee, of which the Milwaukee street railway system was but one. As a telephone man his abilities have won him the highest position in the Wisconsin Telephone Company, and as a banker he is recognized in the directorship he holds in the first National Bank of Milwaukee. Numerous other business enterprises enjoy the benefits of his counsel and direction, and, as if this were not enough to keep one man busy, his constituents have repeatedly thrust upon him political responsibilities of the highest order. Not only has local and state politics, but also has national politics, felt the influence of his great personality, for several times has he represented the Republican party as delegate-at-large at national conventions.



As the official head of the Milwaukee Street Railway Company, Mr. Payne will in a large measure act as host at the street railway convention, and this would be sufficient, if all other assurances were wanting, that the affair, not only from a social, but from a business, standpoint, will be one of the most successful in the history of the association.

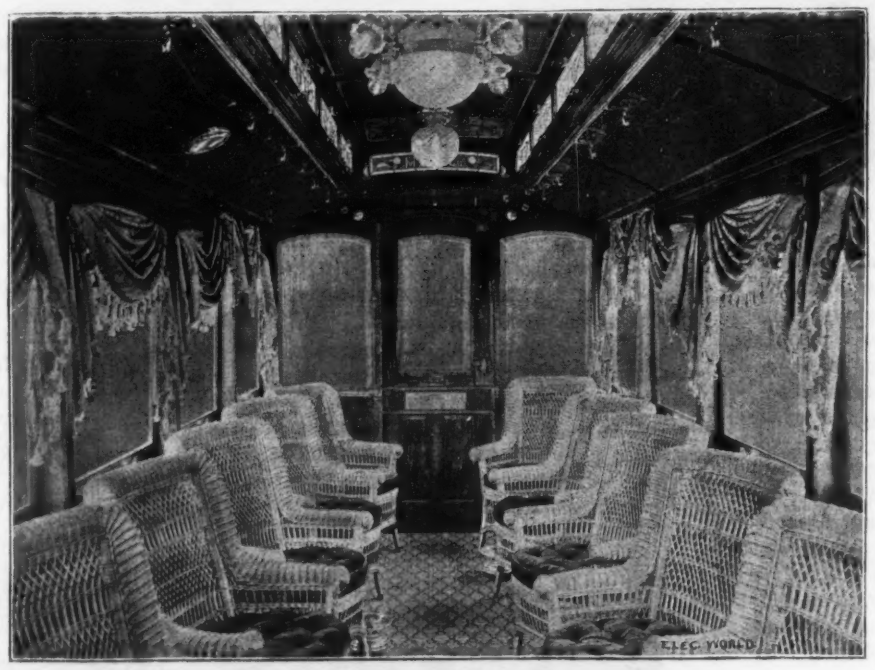
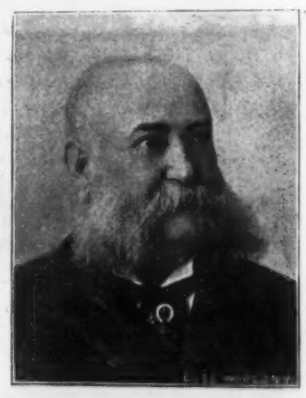


FIG. 8.—INTERIOR OF DIRECTORS' PALACE CAR.

So closely associated with Mr. Payne in the street railway business as to always be thought of when his name is mentioned in this connection, and known as widely in the East as in the West, is

MR. GEORGE W. HOMMELL.

In the executive part of the street railway business there is probably no more competent man in this country than he. Mr. Hommell is distinctively a modest man, but though he is a man of few words and says little of himself, his works speak so loudly for him that his history is pretty generally known. As will be seen, he comes from literary as well as fighting stock, for his father, Brig.-Gen. S. S. Hommell, was the editor and proprietor of the Kingston "Argus," the then Democratic organ of New York State. The death of the elder Hommell in 1863 left the subject of this sketch dependent upon his own resources, and he then began a career of hustling which he has continued to this day.



His early education was in the New York public schools, after which he entered and graduated from college at Poughkeepsie. Among his classmates at college were Cor. Vanderbilt, Barton and other New York boys who have since become famous as railroad magnates. After leaving college young Hommell took a position under his father, who had been appointed Naval Officer of the Port of New York, by James Buchanan. He remained in this position until the close of the war, when he was offered a position with the Third Avenue Street R. R. Co. by Mr. E. S. Dickinson, then superintendent. With this company he remained for 15 years.

The Forty-second Street & Nicholas Avenue Railroad was just completed at this time, and the superintendency of the lines was offered to Hommell. He accepted the responsibilities, and organized the road, and remained with it until Mr. Wm. White, president of the Dry Dock, East Broadway & Battery Railroad, offered him a position with that road. This latter position he held for about two years, when a party of New Yorkers having acquired the ownership of the Milwaukee City R. R. induced him to come west and take charge of their property.

Mr. Hommell arrived in Milwaukee in December, 1888, and has remained there ever since. When he took hold of the road it was operated almost entirely by 12-foot cars drawn by small mules. These cars were of the bobtail variety and employed no conductors at all. This was a very crude state of affairs for a man to find himself surrounded by who had been railroading in the East for from 25 to 30 years under the most favorable auspices. Of course, either he had to change his ideas radically or the conditions as he found them had to be bettered. Those who visit Milwaukee to-day find it possessed of one of the finest systems of railways to be found anywhere in this broad land, and there is none so ungenerous as to refuse to place the credit where it rightfully belongs, and who richly deserves it—with Geo. W. Hommell.

THE BADGER ILLUMINATING COMPANY.

While the Milwaukee Street Railway Company is the largest producer of electricity in Milwaukee, and through its illuminating plant one of the chief of those furnishing light for commercial purposes, there are other plants of importance in the illuminating field. Chief of these is the Badger Illuminating Company, whose station is located between Commerce street and the river, just west of Third street. This company confines its attention exclusively to arc lighting, and the equipment of the station throughout is with Thomson-Houston apparatus.

All of the circuits are underground, cement pipe being used for the main lines and sewer pipe in two-foot lengths being used for the subordinate conduits. These are all laid in concrete, and the largest subway consists of 18 three-inch ducts. Manholes are placed at intervals of from 150 to 250 feet, and are usually of brick, three feet in diameter and from 4 to 4½ feet deep. At junctions the manholes are larger. Ventilation, accomplished by connections with the adjacent lampposts, has thus far proved entirely adequate.

The city ordinance requires that within five years from June 1, 1892, all wires in Milwaukee shall be placed underground. This company has anticipated the requirements, for, as before stated, its wires are already all underground and within the limits of the law

THE POWER STATION.

The boiler plant consists of four Reynolds vertical boilers, rated at 300 h. p. each, one Hazelton of 400 h. p., and one pair of tubular boilers of 150 h. p. each. These furnish steam to three Allis-Reynolds Corliss engines, two of 350 h. p., coupled to a common shaft, and another of 175 h. p., one Hoffman & Billings engine of 400 h. p., and one Vilter's Manufacuring Company engine of 600 h. p. All of these engines, it will be observed, are of Milwaukee make; they are all compound condensing, and jet condensers are employed throughout the establishment. The belting used is the Schieren, Chicago Belting Company, Munson and Alexander chiefly.

In 1871 this station started with one machine supplying three or four lights; to-day the dynamo equipment consists of twenty-four 50-light, two 35-light, and two 25-light machines, 28 in all.

Something over 1,200 lamps are in service, 760 of these being municipal, and the remainder, 480, to be exact, are commercial.

The city lamps are placed at all street intersections, which are usually 320 feet apart on the east and west streets and 420 feet apart on those running north and south. For these the company has a contract with the city at $110 per lamp for all-night service. For commercial service the charge varies, but is usually at the rate of six cents per hour.

One of the most interesting features of the generating station is the unique switchboard by which the circuits are controlled. This was designed by the company's superintendent, Mr. S. G. Coleman, to whose indefatigable zeal much of the success of this plant is due. This switchboard consists of a series of double hooks for changing machines, the positives all being on the

right side of the board and the negatives on the left, so that a short-circuit through carelessness is impossible.

The officers of the Badger Illuminating Company are: President and general manager, E. C. Wall; vice-president, D. S. Wegg; secretary and treasurer, R. L. Jennings; superintendent, S. G. Coleman; and the officers are at Nos. 13, 14, and 15 Colby & Abbot Building, adjoining those of the Milwaukee Street Railway Company.

THE PABST POWER PLANT.

What bids fair to become a strong competitor for popular favor in the electric lighting and power field is the new Pabst lighting and power plant only recently completed. The building, which is a model one for such purposes, is but a stone's throw from the elegant Pabst office building, and will be most interesting to the attendants on the convention, as embodying several features that are new in central station construction. It is equipped entirely with Siemens & Halske apparatus, and that company has introduced controlling devices not yet used elsewhere in this country. The generators are all multipolar, employing the cylindrical surfaces of the armatures as commutators, and they are all directly connected, as is the custom of that company.

The power for running the elevators in the great Pabst Building, the handsomest office building in Milwaukee, is derived directly from the boilers in this power station. The illumination of the building is also provided from circuits from the Pabst station. A commercial lighting business is also done.

In addition to the above mentioned public lighting plants, Milwaukee boasts of a number of isolated plants of considerable size. The largest of these, of course, are in the various immense breweries for which the city has long been famous.

OTHER POINTS OF INTEREST.

While Milwaukee is exceedingly well equipped electrically, it is not famed for the number of its business houses engaged in the manufacture and sale of apparatus solely used for electrical purposes, but there are a few of these that seem to have almost entirely monopolized that trade. In this line the old and well known house of

JULIUS ANDREA.

stands pre-eminent. This house, whose business is located at 225 West Water street, was founded some 25 or 30 years ago, and now does a large business both inside and outside of the city. The electrical department, in which we are most interested, is in charge of Mr. Hermann Andrae, to whose skillful and efficient management its marked growth is chiefly due. Julius Andrae is the agent of the Mather Electric Company and also for the celebrated Okonite wires. He does a general contracting business also, and has recently installed a plant of 2,000 lights in the Davidson Theatre; one in the "Daily Journal" offices, which not only furnishes the light, but also the power to run the type-setting machines used on that paper; one for the Northwestern Furniture Company of 250 lights; one of 400 lights for Layton & Company's packing houses; one of 400 lights for the Zoehrlant Leather Company; one of 150 lights for the George Martin Leather Company, and another of 200 lights for the John Schroeder Lumber Co.

Mr. Andrae also equipped and furnished the plant for the Val Blatz Brewing Company. This consists of Mather machines throughout, viz., 400 h. p. in generators and 30 or 40 motors. There are 2,000 lights wired, and the different departments of the brewery are connected by underground cables.

Mr. Andrae is also the agent for the Schnider electric lock, which is proving a very popular invention for insane asylums. Three years ago he fitted up one ward of the Milwaukee Insane Asylum with ten of these locks. He has recently received an order for 185 more of these locks from the same source. When these are placed in position they will all be connected with the office, so that in case of an emergency, such as fire, they may be all or severally controlled from that point.

THE JOHNSON ELECTRIC SERVICE COMPANY.

The principal offices of this company are located in Milwaukee in the spacious quarters 118-120 Sycamore street. The chief specialty of this company is its system of electrical heat regulation for buildings. This system is very fully exemplified in Milwaukee, where in six of the leading hotels, viz., the Pfister, Plankinton, St. Charles, Republican House, Davidson and Hotel Aberdeen, the steam heat is entirely controlled by the Johnson Heat Regulating Apparatus. In all of these the temperature of the rooms is maintained at 70 degrees Fahr. all the year round, and in the Pfister and St. Charles the arrangement is such that the clerk in the office can shut off the heat from any room when desired. The apparatus, in brief, consists of a thermostat located in the room whose temperature is to be regulated, and connected by an electric circuit with a pneumatic valve in the basement, by the operation of which latter the dampers of the heating flues of the furnace are opened or closed. The electric current does not directly control these dampers, but simply determines the throw of a pneumatic valve, and the compressed air, whose course is thus directed, performs the actual work of opening or closing the dampers. The electric current is thus seen to be simply directive, and sufficient is thus supplied by one or two cells.

A series of temperature cards kept by the teachers in the St. Paul schools where this apparatus has been in use show that the variation in temperature was only three degrees in five months.

As a fuel saver, this apparatus also ranks high. In the public schools of Milwaukee during the winter of 1885-6 the official records in the office of the secretary of the school board show a saving of 14.6 per cent. of fuel in the Ninth and Tenth District schools, where it had been applied. But the saving of fuel, important as this is, is, of course, secondary to the conservation of health which is attained in the highest degree by the maintenance of an unvarying temperature throughout violent atmospheric fluctuations. Being entirely automatic, this apparatus commends itself to all interested in the subject of heating, not only of dwellings, but of schools and office buildings.

WADHAMS OIL AND GREASE COMPANY.

Street railway men will be particularly interested in the products of this company, which, though not electrical in themselves, have a wide application in electric street railway practice. This company has its main office and factory at 116-120 Fowler street, Milwaukee, and a branch house at Seattle, Wash. The officers of the company are: E. A. Wadhams, president; E. C. Kirby, vice-president; Geo. B. Graves, treasurer; J. M. Campbell, secretary. The specialties manufactured are Wadhams' graphite curve grease and a full line of cylinder, engine and dynamo oils.

The graphite curve grease is a soft grease easily applied with a stiff brush or with a paddle, and is composed of a mixture of a high-grade grease and best quality of flake graphite. The graphite works into the pores of the iron and steel, giving a smooth and polished surface to the rails, and causing the lubricant to last longer than any superficially applied. It has been in use for five years with satisfaction, as evidenced by testimonials from all over the country, and is no longer an experiment. The O'Connell greaser is another specialty of the Wadhams company, and is used for forcing a solidified oil upon the crosshead and crank-pin journals. It has been adopted by the leading marine and upright engine builders for the past three years, and is used on the Edison marine engine. For this purpose a special grease called "greaser" grease is employed. The O'Connell greaser may be seen in use in Milwaukee on Starke's Milwaukee Tug Line and elsewhere. The Wadhams Oil and Grease Company have recently renewed their contract with the United States Government for supplying the Wadhams graphite axle grease.

But if Milwaukee is not particularly noted for its business in supplies of a purely electrical nature, it is noted for its manufactures of another kind, without which commercial electricity would be impossible with our present knowledge—we refer now particularly to steam engines. Certainly no city in this country stands higher in this branch of manufacture than does Milwaukee. First of all, the factories of this class, on account of its great extent and wide reputation, must be mentioned.

THE EDWARD P. ALLIS COMPANY.

Probably no visitor to the World's Fair has failed to see the great quadruple expansion condensing engine, located in the south centre of the Palace of Mechanic Arts, manufactured by this company. This engine bears somewhat the same relation to the World's Fair as did the great Corliss engine to the Centennial. It has a rated capacity of 2,000 h. p. to 2,500 h. p. when working under such conditions as to develop the best economy in steam consumption, but has a maximum capacity of from 3,000 h. p. to 4,000 h. p.

The steam passes successively through four cylinders, doing a part of the total work in each, and then to the condenser. The first, or high-pressure cylinder, is 26 inches diameter; the second, or first intermediate, is 40 inches diameter; the third, or second intermediate, is 60 inches diameter, and the fourth or low pressure cylinder is 70 inches diameter. The stroke is 72 inches and the speed 60 revolutions per minute. The balance wheel, 30 feet diameter by 76 inch face, weighs 150,000 pounds, and the total weight of the engine is 315 tons. This engine drives two large Westinghouse generators, each rated at 13,000 16-c. p. lamp capacity. This is the engine, it will be remembered, that President Cleveland set in motion by the pressure of a Victor key at the opening ceremonies of the Exposition, and much more powerful than the great Centennial Corliss engine before referred to, which was designed to develop only 2,200 h. p.

Another great engine manufactured by this company, which street railway men who have been to the Fair most certainly have seen is the one driving the great 1,500-kw. generator—the largest in the world—in the intramural power station. This was fully described in The Electrical World for May 6, but as that edition has long since been exhausted, it may be well here to recapitulate the more important data. This engine is a cross compound Reynolds-Corliss having low pressure cylinders 62 inches diameter and the high pressure cylinders 32 inches in diameter. It is direct connected to the armature shaft through two crank discs 7 feet 4 inches in diameter, and has a stroke of 5 feet. The flywheel, which was shipped in 10 pieces, is 24 feet in diameter, 24 inches face, and has a rim 20 inches deep. Its total weight is 85 tons.

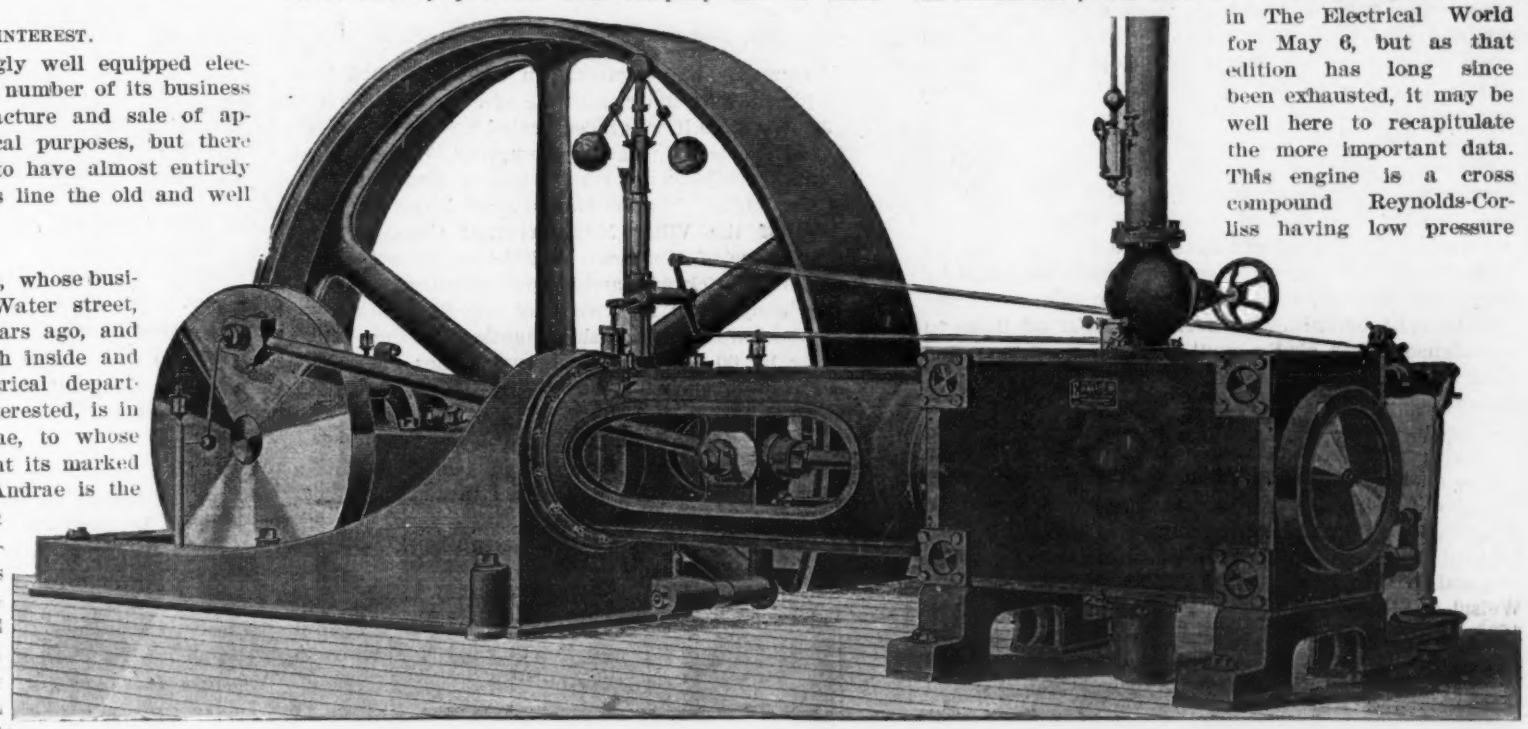


FIG. 9.—ONE OF THE ALLIS CORLISS ENGINES.

Every one who has seen these two great engines will have a desire to see the works that produced them, and the opportunity will be afforded those attending the Street Railway Convention of doing so, as one of the excursions planned by the Committee of Arrangements is to the great E. P. Allis works.

These are situated in what is known as the South Side of Milwaukee, and cover 27 acres of ground. With the galleries and floors there are 60 acres of floor space. The company have only recently completed a new addition to their already enormous plant, which is a machine shop for heavy work, and known as the "New Shop." This is 300 feet long by 100 feet wide, and 70 feet high from floor to roof. This has two electric traveling cranes for handling the heavy pieces—one of 50 tons and one of 20 tons capacity.

In the foundry proper, which is another building, there are three cranes—two of 30 tons and one of 20 tons; in what is known as the Reliance machine shop there is a 15-ton crane, and in the north erecting shop there is a 30-ton Morgan crane. The buildings are also illuminated by an electric plant of their own, which consists of two 50-light Thomson-Houston arc machines and one Edison 750-light 110-volt incandescent. United States machines furnish current at 110 volts for all the cranes and for 600 lights besides. Of the cranes before referred to the following additional data may be given: The 50-ton, the two 30-ton, the two 20-ton, and the one 15-ton cranes are all of the Shaw Electric Crane Com-

pany's make, of Muskegon, and are of the three-motor type. The 30-ton Morgan crane is of the square shaft type, and is not electrical.

When this company began the manufacture of Reynolds-Corliss engines in 1877, Eastern engine builders prophesied a speedy failure on the ground that there was no demand in the West for a high-class engine. Time has shown the fallacy of these predictions, and in no way has it become more apparent to the superficial observer than in the extent of the plant now required to enable the company to keep pace with its orders. The average number of men employed is 1,500; the average monthly pay-roll, $75,000; the approximate value of manufactured products per year, $3,000,000; average receipts and shipments in carloads per year, 8,000; average outputs in castings per month, 3,300,000 pounds.

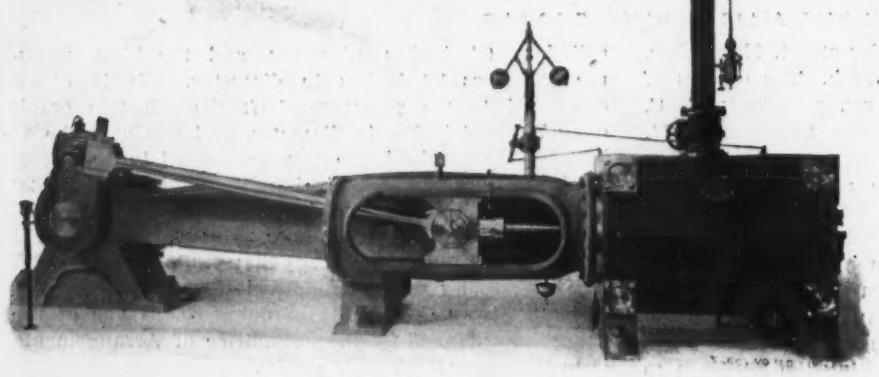
Nor has the business of the company bee confined to the West. It has extended as far East as Boston, where the largest steam power plant in the world, the West End Street Railway plant, was equipped by this company, and its engines are found driving railway and lighting generators in nearly every city of importance in the country. The officers of this company are: Wm. W. Allis, president; Edward P. Allis, Jr., vice-president; Edwin Reynolds, second vice-president and general superintendent; Charles Allis, secretary and treasurer.

But interesting as are the E. P. Allis works, they are by no means the only interesting or important engine works in Milwaukee. Still further toward the South End, clustered together, near the intersection of Clinton and Beecher streets, are three other concerns, engaged in the manufacture of engines of the highest grade and efficiency. These engines are also known all over the country and especially among electric light and street railway men, who only want the very best. These establishments are those of the Vilter Manufacturing Company, Filer & Stowell and Hoffman & Billings. These establishments are all of great extent, and only seem small when compared with the larger E. P. Allis works, which, however, do not confine their output to steam engines, but also turns out flour milling machinery, saw mills, etc.

For some reason or other the programme of the convention does not include a visit to these works, but we feel sure that the visitors who leave Milwaukee without having seen them will have missed much. We believe also, that if concerted action were to be taken by these three firms by which an invitation should be properly brought before the convention, most of those in attendance would gladly avail themselves of it, and a time and place would be found for it upon the programme.

THE VILTER MANUFACTURING COMPANY.

This company, formerly known as the Weisel & Vilter Manufacturing Company, manufacturers of Corliss engines, etc., was established in 1867 by Peter Weisel. In 1879 it became known by the name of Weisel & Vilter, and in 1886 it was incorporated under the name of Weisel & Vilter Manufacturing Company. In October, 1892, the entire plant was destroyed by fire. A reorganization then took place, the name was changed in March, 1893, to the Vilter Manufacturing Company, and 6½ acres of ground were procured on the Madison division of the C. & N. W. R.R., fronting on Clinton street, between Beecher and Lincoln avenues, where the present buildings were erected.



THE VILTER CORLISS ENGINE.

The main building, which is used as a machine shop, is 305 feet long, 80 feet wide and two stories high. Adjoining this is the two-story office building, 40 by 60 feet, and parallel with these two is the storeroom, 60 by 60 and three stories high. Adjoining this is the pipe shop, 60 by 180 and 1½ stories, and the engine and dynamo house and boiler house occupying an area of 40 by 40 feet. The total frontage of the buildings is 1,140 feet.

In the machine shop is an immense electric crane, made by Pawling & Harnischfeger, of Milwaukee, spanning nearly the full width of the building (60 feet) and having a runway of its full length, 305 feet. It is operated by three T.-H. motors, and has a capacity of 30,000 pounds.

On either side of the runway, upstairs, there is a gallery. That to the east is used as a pattern shop, and that to the west as a pattern loft. Glancing down from these galleries upon the floor below, there was in process of construction at the time of our visit, among others, the following engines: One 1,200-h. p. cross-compound condensing engine for the Minneapolis General Electric Company; one 500-h. p. cross-compound condensing engine for the Green Bay and Ft. Howard Gas and Electric Company, Green Bay, Wis. In addition to these the floor was nearly full of other work in nearly all stages of completion.

It is said that "a prophet is not without honor, save in his own country." While that may be true, it is equally true, probably, that a prophet that has honor in his own country must be a prophet indeed. No higher recommendation of the Vilter engine can be given, therefore, than the statement that it is high favor and largely in use at home—Milwaukee. We have already called attention to the fact that the Vilter engine was in use in the Badger Illuminating Company's plant. The company is now building others for the Milwaukee Power and Lighting Company, for the West Milwaukee Railway shops, and for the Sheboygan Electric Light Company, as well as for various others.

The electric light and power for this establishment is furnished as follows: A T-H. bipolar, 110-volt, 400-light generator furnishes current for both the incandescent circuits and for the crane. A 25-light T.-H. arc machine is also installed, which furnishes current to 12 arc lamps. Both of these generators are driven by a 16 by 36 116-h. p. Corliss engine of the company's own make.

THE FILER & STOWELL COMPANY.

This company was organized in 1867, and until 1883 was a partnership under the style of Filer & Stowell & Co. At that time it was incorporated under the present name. This establishment is also a very large one, and its engines are known for their merits throughout the western country. The buildings located directly east of those of the Vilter Manufacturing Company and south of those of Hoffmann & Billings, are substantal structures of brick and architecturally attractive. The machine shop is 80 feet wide by 350 feet long. The machine and woodworking shop, another building, is 130 feet long by 60 feet wide and four stories high. The pattern store house is 90 feet wide by 125 feet long, and is five stories high, and the foundry is 90 feet wide by 22 feet long. These buildings have every convenience, being lighted throughout by a 30-light Iemens & Halske arc machine and a 300-light Edison incandescent machine.

The shipping facilities of this firm are unexcelled, as the property upon which the buildings are erected lies between the tracks of the Chicago, Milwaukee & St. Paul and the Chicago & Northwestern railroads.

North of Filer & Stowell is the extensive plant of the Hoffmann & Billings Mfg. Co.

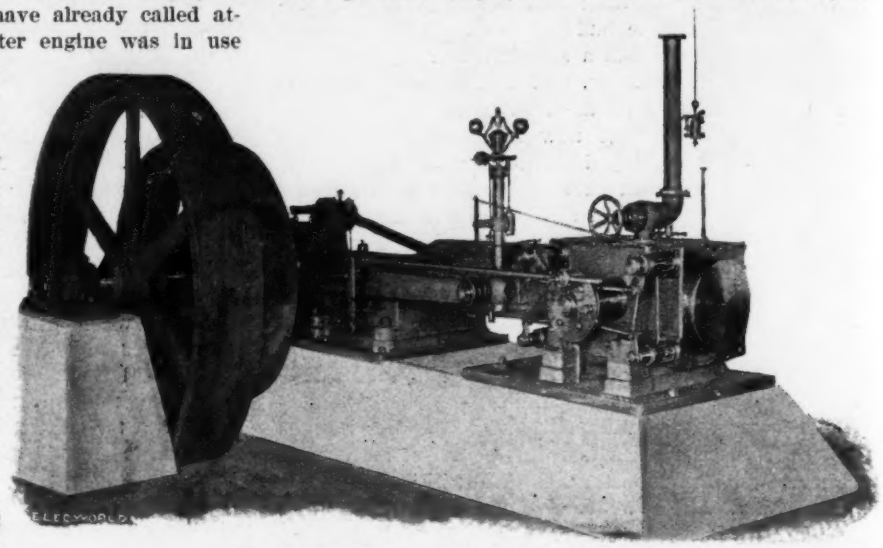
The office is at 141 West Water street, but the works are on the south side, and consist of the following buildings, covering 3½ acres of ground, at 178-200 Beecher street: Iron foundry, 90 by 180 feet; pipe foundry, 80 by 140 feet; brass foundry, 60 by 100 feet; machine shops, 90 by 200 feet, and three stories high; pattern and storage building, 60 by 75 feet, and seven stories high. The officers of the company are: President, Fred Hoffmann; vice-president, C. H. Kalvelage; secretary and treasurer, J. B. Kalvelage.

The chief specialties of this company are improved Corliss engines, and in their manufacture they employ a new pit lathe, which is worthy of notice. This lathe is capable of boring cylinders from 6 inches to 20 inches in diameter, and of turning from 10 to 30 feet with a speed not exceeding 15 feet per minute.

One of their Corliss engines, a 19 by 34-44 tandem compound engine of 400 h. p. may be seen in regular operation in the plant of the Badger Illuminating Company. The company is building a new frame engine especially for street railway work, whose salient points are worthy of mention at this time. In this the frame, including the cylinder, is all one casting, and the centre line is very low, making a very compact machine. Square corners are avoided, and in this way the greatest strength is obtained with the least metal. The factor of safety throughout the machine is 20. One of the most prominent features of this engine is the large foundation bearing surface, which gives and maintains perfect alignment. Another is that the whole of the frame is of one piece, and this is tied together to prevent the liability of guides springing apart, which is especially liable to occur when the engine runs under instead of over.

The clearance space is reduced to about two per cent. of the piston displacement by virtue of a double-seated exhaust valve. The auxiliary seat of this opening a little in advance of the main seat, and filed to perfect alignment with the main and auxiliary ports, entirely cuts off all communication between the cylinder and the exhaust valve chamber during time steam exhausts in the cylinder.

The governor employed is of the usual fly-ball style,



THE HOFFMAN & BILLINGS ENGINE.

with heavy centre weight, and so constructed to limit rise and fall to about one-third that common to such regulators, and by means of a simple attachment gear-segments gives throw at valve gear sufficient to allow engine to follow full stroke or to cut off before point of opening. Any intermediate position is reached in shortest possible time as the load varies.

The piston is made adjustable in relation to its centre line by means of a separate bull ring inclosed between the piston proper and the follower, which, as the piston wears at the bottom of the cylinder, can be raised to original alignment by means of adjusting screws. The packing ring has but one spring for each of the two rings, which set out the ring circumferentially and self-centre the ring in the circumference of the bore, and thus relieve friction. The cylinders of these engines are covered entirely with sheet metal casing.

THE EXHIBITS AT THE CONVENTION.

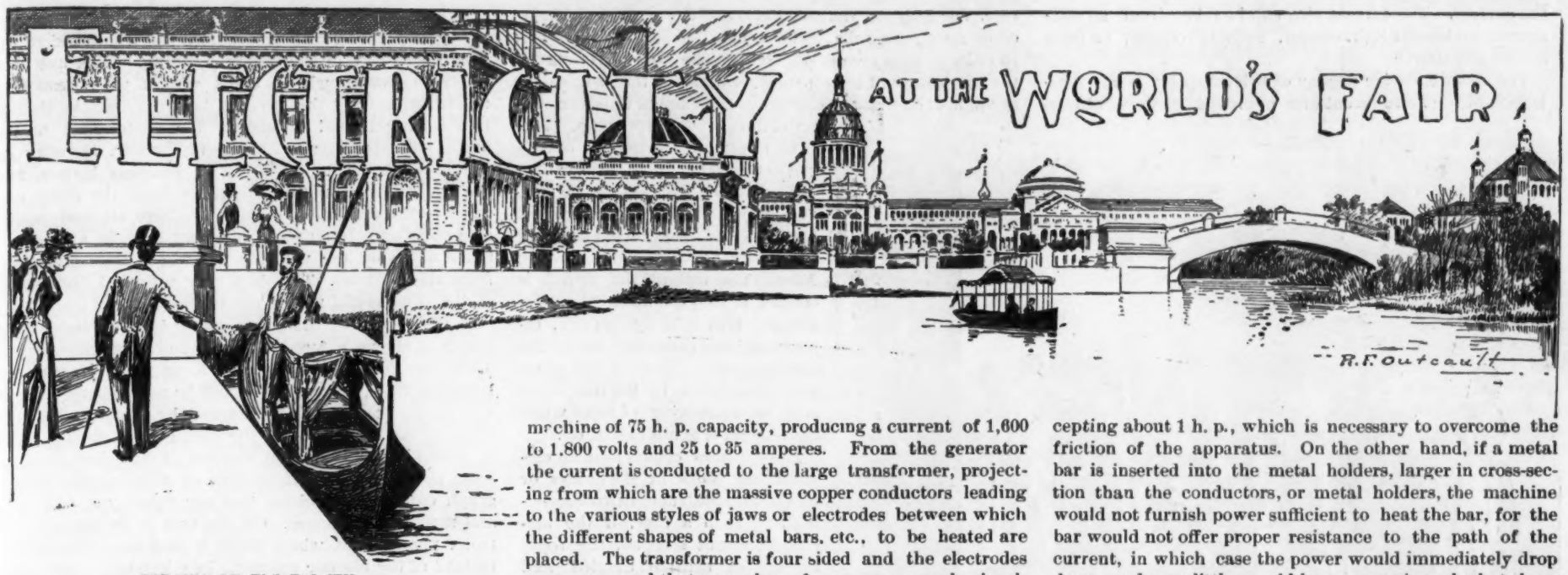
The exhibition of street railway appliances is expected to be most extensive and interesting, and every preparation to facilitate exhibitors that could be thought of has been made. Most of this exhibit will be made in the large hall of the Exposition Building, where current will be furnished to those desiring it. The charge for current so used will be included in the charges for space, light, heat and power. A special line of cars will be run between the Exposition Building and the Pfister Hotel via the Plankinton for the convenience of attending delegates, and over this route, too, will be operated the special exhibits of cars and motors. If the exhibitor have a car to exhibit, the Milwaukee Street Railway Company will furnish motors and track, and if he have motors and trucks, the car will be furnished to complete the outfit. Current for the purpose will be supplied free.

Electric Cooking.

The London "Electrical Review," in a recent issue published illustrations of a number of utensils for applying electrical heat to cooking and heating, as made by an English firm. The heat is generated in wires secured in a cement, which is applied in a cold state, and which, it is said, does not crack under the greatest heat. The following data may be of interest: 1 kilowatt will heat a pint of water from 60 to 212 degrees F. in 3.7 minutes, or a 300-watt kettle will boil a pint of water in 12 minutes; at 12 cents per kilowatt-hour the cost will be .72 cent; 300 watts will fry four or five cutlets in 12 minutes, including the time of heating the pan; the cost will be .8 cent; in an oven 400 degrees was obtained in 15 minutes with 20 ampères at 100 volts; with 6 ampères it is said that an ordinary room, 12 by 10 feet, can be well heated.

Paris Universal Exhibition, 1900.

A decree organizing the proposed Paris Universal Exhibition of 1900 has been published in the French "Journal Officiel." Accompanying the decree is a report by the Minister of Commerce, M. Terrier, explaining that the unprecedented scale on which the project is to be carried out, the difficulties which may arise in regard to the retention of some of the buildings on the Champ de Mars, and the means to be adopted for the conveyance of visitors, necessitate this early notification. M. Alfred Picard, who filled the office of "Rapporteur Général" for the 1889 Exhibition, is appointed Commissary-General.—*London "Electrician."*



FORGING BY ELECTRICITY.

Perhaps no other exhibit in the Electricity Building excites the interest of the many visitors as does that of the Electrical Forging Company, of 163-167 Oliver street, Boston, Mass. At almost any time crowds may be seen standing before this display watching with curiosity the various processes of forging, and especially manifesting intense interest in the actions of the operator when he seizes a common iron spike and places it in a pail of water, with the result that the iron comes to a white heat and glows beneath the water. This experiment never ceases to be a source of attraction, and the company could not have selected one which would have gained greater popularity for its exhibit.

The name of Mr. George D. Burton is well known in the electrical field, and it is to the patient and intelligent work of this inventor that the success of the system advocated by the Electrical Forging Company is largely due. The patents owned by this company are the inventions of Mr. Burton and Mr. E. E. Angell, and cover not only the heating and forging of metals in all forms, but the smelting of ores, cooking of food, heating of buildings, etc. It is claimed that forging by this process is quite different from the simple welding in other systems, and possesses many advantages over its rivals.

The accompanying general view of the exhibit gives an excellent idea of the company's plant as installed at the Fair. The generator is a specially designed alternating machine of 75 h. p. capacity, producing a current of 1,600 to 1,800 volts and 25 to 35 amperes. From the generator the current is conducted to the large transformer, projecting from which are the massive copper conductors leading to the various styles of jaws or electrodes between which the different shapes of metal bars, etc., to be heated are placed. The transformer is four sided and the electrodes are so arranged that a number of men may work simultaneously about the device. The power of the transformer is such that the current is changed from the high intensity of 1,600 to 1,800 volts down to 30 volts while the amperage is proportionately increased to 8,000 or 10,000.

One of the principal features of this system is the regulation, and this is accomplished by placing a rheostat in the exciter circuit instead of the dynamo circuit; the most sensitive regulation can thus be obtained, and the exact amount of power required for any special form of work without the waste which would otherwise result.

FORGING BY ELECTRICITY.

By electrical forging all the various classes of work can be formed which hitherto have been done by the smith's forge, and, further than this, certain classes of work which it was before impossible to execute can now be accomplished without difficulty. It is evident that the economy of the modern system is much greater than that of the old. The amount of fuel required to heat the large number of pieces of metal in as many forges is very much greater than that required to heat the same number of pieces in a single forge. By the electrical process the fuel is concentrated at one point and where the maximum amount of energy can be obtained from it. The heat is also concentrated at the exact point where it is needed, and this is evidenced by the fact that the hand can be placed on the metal being forged within a few inches of the portion which is at a white heat. Furthermore, when no work is being done no power is consumed, excepting about 1 h. p., which is necessary to overcome the friction of the apparatus. On the other hand, if a metal bar is inserted into the metal holders, larger in cross-section than the conductors, or metal holders, the machine would not furnish power sufficient to heat the bar, for the bar would not offer proper resistance to the path of the current, in which case the power would immediately drop down, and very little would be generated, and what there was generated would pass unobstructed around each endless ring of the converter, through the bar held within the metal holders.

Economy in the space occupied by the apparatus is another point of advantage which is claimed. There is also a very great saving of time in the heating of metal as compared with the old method, for a piece of metal that it required many minutes to prepare in an ordinary forge is heated and shaped by this process in almost as many seconds. As the metal is always heated exactly to the degree desired, it does not scale away as when heated in a forge, and the result is that there is little or no waste.

The operation of a machine is so simple that it can be handled by an ordinary workman, and the skilled labor which is essential to hand forging is not demanded; this is one of its important points.

The Electrical Forging Company exhibits a number of metal rolling machines for rolling steel and other metal forgings. It is possible with this machine to produce small forgings with great rapidity, the capacity being from four to eight thousand pieces per day; it is apparent that this is a rapidity which cannot be approached by the old methods.

The simple experiment referred to in the early part of this article has also a practical application and is an exceedingly convenient device for heating metal, for it can be applied at any point where a pail of water can be placed, whether it be a foot or a mile from the dynamo generating

the current. The current also can be taken from an ordinary incandescent light circuit, railway circuit, or from almost any source.

The comprehensive display of this company is an illustration of the more recent and approved methods of electrical forging and is not only of interest to the curious sightseer and to the practical engineer, but is of value from an educational standpoint as well.

WATCHING THE ELECTRICAL FORGING PROCESS.

THE ELEKTRON MANUFACTURING CO.'S EXHIBIT.

The Elektron Manufacturing Company, of Springfield, Mass., has made a comprehensive exhibit in Electricity Building, and in addition has made life less burdensome to many a weary sightseer by running an elevator from its space near the northwest corner of the building to the gallery above. It has received a well merited reward in the shape of an award for multipolar low-speed motors, being the only award granted for this type of motor, and also an award for automatic motor starters.

Most of the machines shown in the exhibit are of the well known six pole Perret type, and among them may be mentioned a 15-h. p. 500-volt motor taking current from Machinery Hall, belted to a 75-ampere 110-volt dynamo, whence the current is led to a marble switchboard with line switch, rheostat, ammeters and voltmeters, pilot lamps, circuit switches and cut-outs. From here the current goes to four incandescent arc lamps, several fan motors, and to a 1-h. p. motor belted to a Goulds triplex pump, pumping water into a tank overhead a little faster than it is allowed to escape by a pipe in the bottom. Current is thrown on the motor automatically by a float in the tank connected with a switch and operated at any predetermined level, while a solenoid in the circuit cuts out the resistance slowly and avoids any danger of injury to the motor. When the tank is full the float rises and throws off the switch, stopping the motor and pump until the low water mark is reached.

A 4-h. p. 500-volt motor is also shown driving a 50-ampere dynamo. The resistance boxes for the motor, together with their switches, are all mounted together on a pillar close at hand.

The most important part of the exhibit, however, is the elevator mechanism. The motor is a six-pole 500-volt Perret machine of 10 h. p., with a series connection between the armature and the commutator permitting the use of only two carbon pencil brushes instead of six and insuring freedom from noise. The motor is directly connected to a worm shaft, by a universal coupling, so arranged that the worm and motor shafts can thrust either way independently. The worm is cut directly on the steel shaft instead of being sleeved, and the gear is of bronze, hob cut, with a ratio of one to forty with the worm, and is bolted to a wide web, which, besides being keyed to the drum shaft, is bolted directly to the drum as an additional precaution in case of the key working loose.

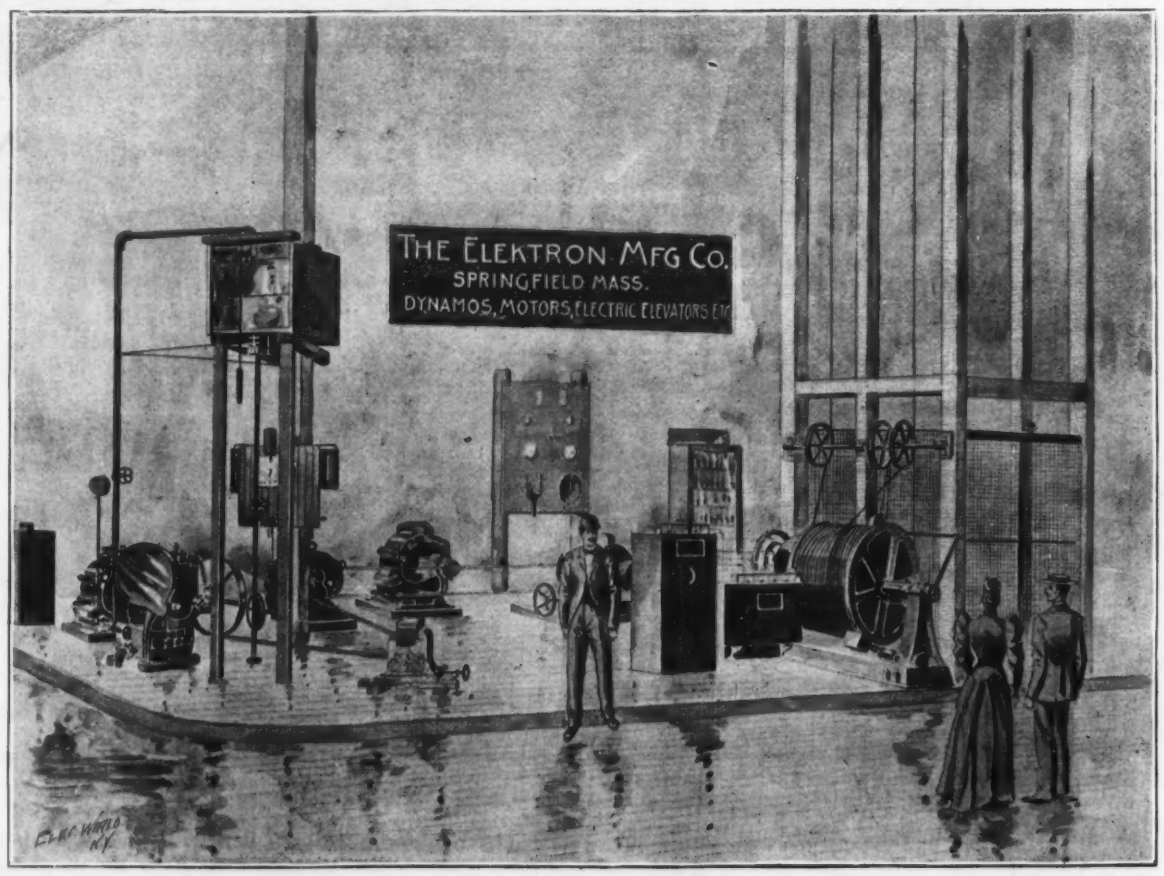
The elevator hand rope throws in the starting switch, and at the same instant releases a brake strap extending four-fifths of the way around a brake wheel on the worm shaft, which is reapplied when the switch is opened, and stops the car by the action of a heavy weight at the end of a compound lever. The brake shaft is directly connected to, though insulated from, the switch mechanism, and in neither direction of running is the circuit completed until after the pole changer has been thrown into contact.

The starting rheostat is entirely automatic in its action, and the important points are covered by a patent recently granted to Mr. F. A. Perret, and owned by the Elektron Manufacturing Company. A solenoid is employed to move an arm which traverses a row of contacts, cutting out the resistance step by step in the usual way, and a dash pot is employed to prevent the moving of the lever at too rapid a rate. The dash pot, resistance arm and contacts are not especially novel, being changed but slightly from ordinary forms in order to give greater durability. The novelty is found in the connection of the solenoid terminals to the brushes of the motor, so that the solenoid is not excited until the motor commences to speed up. This is an important feature, for in case the car is very much overloaded, the resistance will not be cut out, and only a predetermined current can pass the resistance and enter the motor. This prevents blowing fuses. The instant the switch is opened to stop the machine the resistance arm falls by gravity, reinserting the resistance ready for another start. Thus, in case of an accidental break in the line there will be no blowing of fuses when the current is again turned on.

It sometimes occurs that an elevator car sticks in the guides or meets with obstructions in descending; in such a case, if the machinery is not stopped, the ropes are apt to became tangled and give trouble. This possibility is also taken into account and provided for by an ingenious and simple device. The hoisting rope as it leaves the drum passes beneath a loose sheave on a frame whose ends are fixed to loose collars surrounding the drum shaft. At the end next the motor is a catch holding back one-half of a clutch turning with the shaft, capable of sliding along it when released, under the action of a spring actuated collar. The other half of the clutch is fixed to the motor controlling sheave. When thus, by reason of the car's sticking or being obstructed on its downward trip, the hoisting ropes become slack, the sheave under which they pass is no longer supported and, with its frame, falls, releasing the movable half of the clutch, which immediately meshes with that on the controller sheave and cuts out the motor. To guard against "racing" there are two weights inside the drum acting like governor balls, and when the speed becomes too great releasing a weight that sets a heavy auxiliary brake and brings the drum to rest. As an additional safeguard against accident from allowing the car to go too far in either direction a travelling nut on the controller sheave shaft is set so as to engage, at the desired instant, a fixed nut at either end of its rim and automatically cut out the motor. The rheostat is not mechanically connected in any way with any of the other apparatus, and may be placed in any convenient spot.

The rest of the display consists of small motors, motor generators for changing from direct to alternating current, and from high to low tension direct current, and parts of apparatus showing their construction. As almost all the machines are shown in operation they excite a great deal of interest among the visitors, laymen and professionals alike, who throng the Electricity Building both by day and by night.

The exhibit is in charge of Mr. M. H. Robbins, Jr., who looks well after the interests of the company.



AN EXHIBIT OF MULTIPOLAR DYNAMOS AND MOTORS.

NORTH AMERICAN PHONOGRAPH COMPANY'S EXHIBIT.

This interesting display occupies the whole end of the western gallery in Electricity Building, which has been fitted up handsomely in black walnut with glass partitions separating the various departments. At the extreme eastern end is shown the commercial phonograph in operation with the typewriter, showing its use in dictation as employed in business houses, and the transcribing on the typewriter from the letter dictated to the machine. Visitors are here allowed to dictate their own letters and a young lady in attendance takes down on the machine the words thus given out from the cylinder. This is a very practical illustration of the commercial use of the phonograph.

In the centre of this same space is a pyramid upon which is shown a fac-simile of the original phonograph made by Edison, now at the Kensington Museum at London. The phonograph, it will be remembered, was a very bulky round cylinder, turned by hand, and which received the impression of the sound wave upon a sheet of tinfoil carefully wound thereon. Just below this are some specimens of a later type of phonograph, phonograph cylinders, speaking and ear tubes, ear trumpets and magnifying phones. On the east is shown a water motor phonograph, where water is used as motive power instead of the electric current. In a handsome oak case, not unlike that of a sewing machine, is also shown a phonograph geared to operate by treadle.

It often happens that a number of people desire to hear a reproduction at once. For this purpose many tubes are made to be connected to a single instrument so that as many listeners may hear. A 14-way tube, to which 14 different ear trumpets may be attached, is shown here. On the other side of this pyramid are shown several machines of various types. Surmounting the whole is a bronze bust of Thos. A. Edison.

On the south wall, between two windows, is a sample board in oak frame showing the various parts of the complete phonograph, and near it are shown samples of hearing tubes, and among these is one of the 14-way hearing tubes. The nickel-in-the-slot machine is illustrated by a number of cabinets.

In the centre of the south wall is an interesting cabinet, which, for a better name, may be called a phonograph exchange. It is an oak desk having upon its top three of the commercial phonographs of the latest type. These three phonographs are connected by means of speaking tubes to six different rooms or offices. They are also electrically connected so that any one in any of the rooms so connected desiring to dictate to a machine by pressing a button at his desk liberates a drop on a cabinet similar to a telephone call and the operator will then connect him up with one of the three machines. He may then dictate to his machine, and when through with his letter give another signal to indicate that he has finished, and the operator will remove the cylinder and hand it over to the typewriter. She will place it in writing upon her typewriting machine, and thus the whole work may be accomplished without one's having seen the instrument or having done more than perhaps would have been required had he dictated in the adjoining room to the ear of the operator instead of the machine. This last device is the idea of Mr. T. R. Lombard, who is general manager of the Edison phonograph, and has charge of the Edison exhibit in Electricity Building.

Near this to the west is a very handsome commercial machine of the ordinary type, using the India rubber mandrel instead of the old fashioned mandrel of brass.

The room to the west of the central room, which is handsomely partitioned off in beveled glass, is called the "parlor" or "drawing room." In this are exhibited a number of phonographs handsomely mounted and especially prepared for amusement purposes, although not different in essential parts from the commercial instrument. Here the visitor will be entertained as desired, with brass band or vocal music or the conversation of some one whom he may know by reputation, and it needs but little stretch of the imagination to enable one to feel that he is on familiar terms with some great singer or orator or other notability whom heretofore he has only known at a distance. There are five of these machines in this department and several of what are called "double spectacular machines," which is an old type of phonograph now seldom seen. Another bronze bust of Edison, a duplicate of the one before referred to, also adorns this room.

Proceeding to the west room, there is an apartment devoted to the display of the educational use of the phonograph, showing its adaptation in teaching elocution and languages. The scholars are given books which correspond with the cylinder, and as they follow the text from the book the machine gives the proper pronunciation. In the centre is a large cabinet containing an instrument to which are attached ten speaking tubes, one intended to be used by the teacher and the rest by a class of nine scholars, the teacher asking questions and the various scholars in turn answering. The questions and answers are heard by those present, and the apparatus makes a permanent record of both questions and answers; giving, in case of languages, accurately, both the pronunciation and accent. This certainly introduces a most interesting feature in the study of languages, and when the lesson is complete or the examination is over the permanent record is removed, placed in a pasteboard case and labeled for future reference. Thus, one of these cases which the writer picked up bore the following: "14th Lesson in Spanish, book 8, page 213, by Prof. P. Torre, Berlitz School of Languages, for the N. A. P. Co., Masonic Temple, Chicago." This refers to a lesson in the Meisterschaft system. Placing the cylinder upon the machine, we listened to the lesson read off by the teacher, who had been careful with his accent and pronunciation. In this way one having no knowledge of the Spanish language may have the lesson repeated to himself over and over again until his ear has become thoroughly accustomed to it, with all the peculiarities of accent in pronouncing the foreign language. It would seem that the use of the phonograph with the Meisterschaft system is particularly advantageous, since that system is founded upon the principle of educating the ear as well as the tongue to the sounds and expressions as used in the foreign tongue. There are five machines fitted for this work in this room; also an open case or cabinet with glass door, in which cylinders are filed. A collection of handsome photographs, some showing the uses of the instruments in the classroom, including the teacher and her class, and several others showing pupils receiving instructions, are exhibited on the east wall.

The extreme east end of the exhibit is occupied by the display of the Edison Manufacturing Company, of 110 East Twenty-third street, New York, which includes the Edison-Lalande battery for operating fan motors and other light machinery, now found so extremely useful in the well-equipped house.

THE DISPLAY OF THE E. S. GREELEY & CO.

Standing before the exhibit of The E. S. Greeley & Co. at the World's Fair the careful observer cannot refrain from running back over the past 30 years and comparing the state of the electrical field at that time with the present day. Before him are displayed the latest products of human ingenuity in the electrical world which bring into sharp contrast the new and the old. Now even the school children have some conception of the varied applications of electricity and the extent of its field, but in those days even an electric call-bell or burglar alarm was scarcely known, and regarded as an article of luxury.

Alongside of this modern electric bell is a handsome presentation of push buttons in every conceivable variety of form, color and material; burglar alarm instruments performing other services besides ringing a bell, such as lighting the gas, turning on the electric light, calling the servants, releasing certain parts of the house and retaining the remainder under guard, etc.; watchman's time detectors to watch the watchman, electric fire alarm machinery designed to protect all kinds of property, from a private residence, hotel or lumber yard to a municipality; automatic door openers to open distant doors from the desk or bedside by the pressure of a button, or in banks to close them against the egress of a thief, and similar precautionary work.

Electro-therapeutics was then a thing of suspicion, and its manifestations were better known through the trade of street fakirs who paraded imposing nickel-plated apparatus at country fairs and other places of popular public assemblage, while in this display are found a thousand devices in electrodes, cauteries, galvanic and faradic apparatus, approved and used by some of the most reputable physicians in the land, who in these few years have converted into a science what was formerly only a jeer.

The telephone, it is perhaps needless to say, was absolutely unknown 30 years ago, unless perhaps in impracticable dreams that have only lately been brought to notice through patent suits, while the telegraph was scarcely out of its swaddling clothes. Ye old-time relay, costing nearly $25 each, the exhibit shows, has been replaced by a smaller, neater and more effective rival, costing less than one-fifth that amount. The heavy, cumbersome telegraph key of yore, that contributed to dub the telegraph operator a "brass pounder," has surrendered to the graceful trunnionless "Victor key," whose golden prototype under the hand of President Cleveland opened the World's Columbian Exposition on May 1 last. Here also is found the latest types of sounders, repeaters, spring jack switches, primary batteries and all the paraphernalia of Morse telegraphy. Here, too, is the Greeley ink writing register, writing out its message on the white paper ribbon in unmistakable solid black dots and dashes, instead of the unsatisfactory depressions of the steel pin formerly in vogue.

Important as are to-day those branches of electrical industries already referred to, they have been overshadowed in importance by electric light, power and traction development, as illustrated in this exhibit. Electric light, railway and power appliances abound on every side. The tools alone for inside work and outside use in construction of the varied electrical plants are an exhibit in themselves, while the elaborate display of electrical measuring apparatus of the firm's manufacture forms no inconsiderable part of the exhibit. This includes galvanometers of various kinds, Wheatstone bridges, divided meters, resistance boxes, test keys, mercury commutators, voltmeters, ammeters, dynamometers, lamp stands and scales, electrical balances, magneto-electric brakes, standard condensers, and so on, until about all the furniture of the laboratory is comprised in the inventory of the delicate measuring apparatus.

This comprehensive display has proved to be a popular one among the visitors to Electricity Building, and is especially interesting to "old timers."

THE WORLD'S FAIR DISPLAY OF AN OLD-ESTABLISHED HOUSE.

Proposed International Electrical Exhibition in Geneva in 1896.

Even Chicago does not appear to have damped some people's ardor in the matter of exhibitions, and it is just possible that the opening of the magnificent and unique water-works at Geneva in 1896 may be an inducement to many to submit to yet another of these inflictions. The promoters of the Geneva Exhibition hope to be able on the neutral ground of Geneva to hold a really international show, and not a more or less local repetition of the Frankfort Exhibition.—Lond. "Electrician."

The Maintenance of the Overhead Line in Electric Street Railways.

BY J. B. C. HOON.

SOME little time ago I was walking along one of the business streets of a neighboring city and chanced to meet the purchasing agent of a street railway, who asked me to join him on a purchasing tour, and I very gladly did so, as I knew something of the condition of the overhead lines of this road and the trouble that the company was continually having with them, and thought I might learn a solution for the case with positive certainty. The first purchase was some overhead frogs, both standard, and right and left hand, and one or two crossings. For these he paid a price equal to only about one-half that demanded by first-class electric companies for goods of their manufacture. I examined them with some interest to see how it was possible for a company to put such things on the market, if they worked satisfactorily, and make a profit. A careful inspection of these frogs showed very plainly that the trolley would jump out of the frog at least three-fourths of the time; otherwise the frog, though of cheap material, would be rather pleasing in appearance when placed on the line.

The next things demanded were some straight line insulators and holders. These were of the same order as the frogs, and would probably last in service about a year, but they were cheap at first cost. So things proceeded, one thing after another being purchased with the idea of paying the least price possible for everything of its kind in the market, this even being carried so far as to purchase a very cheap grade of grease for use on the motors. This proved a little bit too much for my equanimity, and I ventured to remark to the purchasing agent in my usual mild way that this was the next thing to idiocy. However, this served its purpose in opening up a discussion which proved very interesting to me, and gave me quite an insight into the economical methods for which this road was celebrated. In reply the purchasing agent said in substance that he did not dare to purchase a first-class article and pay a first-class price for it, as the management would not only throw it out and return the goods, but would throw him along with them; in other words, that he would have to look for another place instantly.

This brings up the question of whether it is possible for a road to maintain its overhead line with anything approaching economy so long as this principle of purchasing the cheapest article is pursued. Of course, the sensible man who stops to consider the subject at all must necessarily decide in the negative, but the trouble is that our sensible men who constitute the management of our street railways do not stop to consider the matter as thoroughly and carefully as the occasion demands. They have their own business affairs to attend to, and as a rule leave questions of this sort to be decided by the general manager of the road, looking to him for results from year to year, and it often happens that the general manager obtains his training in horse railways, who demand the cheapest prices as a proof of economy. This general manager has not been trained in electrical apparatus, or, in fact, mechanical apparatus of any description, and as long habit has taught him to buy the cheapest of things for use in horse railways he blandly applies the same rule to the electric railways.

Suppose we consider for a moment the actual cost of putting up two styles of insulators, and see which will prove the most economical in the end. Let us take for our first a sheet mica insulator, which, we will say, costs complete, ready to attach to the standard ear, 60 cents. This, made under hydraulic pressure, and being protected from the weather by its outer covering, should last for ten years at least; in fact, there is no particular reason why it should not last for many times that, as mica does not deteriorate under the conditions in which this is used.

We might suppose the ear soldered onto the line, and hence need not take into account the cost of that. It will, therefore, only be necessary for us to consider the cost of cutting this into the span wire, which we might estimate to be about $1, and the cost of renewal would be about one-half this, which will make the first cost of this $1.60, and the cost at the end of ten years for renewal $1.10. Supposing the insulator to go to pieces at the end of ten years, it will make a total for this insulator of $2.70 for the ten years, or an average per annum of 27 cents.

Now, let us take our cheap insulator, which is made out of some molded material containing more or less asbestos, etc., and which we know from experience will last about one year. It costs the same to cut this in as it does the other, and the same for renewals, so far as work is concerned. We have, then, as a result for the year, cost of insulator, 30 cents; cost of cutting in, $1; total, $1.30. Cost of renewal for insulator, 30 cents; for replacing insulator, 50 cents, or a total of 80 cents, but in this case the renewal takes place every year. We, therefore, have the original cost of $1.30 plus nine renewals at 80 cents, which is $7.20, making a total for the ten years of $8.50, or an average per annum of 85 cents. This should appeal at once to the pockets of the management, for if, in one case, it costs only 27 cents per year by purchasing the best quality of article wherewith to maintain the line, and it costs nearly three times as much to buy the cheapest quality of insulator, what more convincing argument than this is wanted to convince even the most obtuse manager of the utter fallacy of buying the cheap article?

If he follows out the same principle with everything else in connection with his work, it will not be many years before his directors will wake up and want to know the reason why their road is not earning anywhere near the dividends it should on the capital invested.

It is absolutely necessary for those intrusted with the management of electrical roads and properties to get over the great American habit of "Don't think," and use the abundant common sense and brains with which nature has endowed them, as is evidenced by the ability with which they have equipped their road and revolutionized the method of transit in the remarkably short space of time since electric railways were first put in successful operation.

Having traveled far enough on the way of costs of material, etc., let us turn our steps toward the condition of the overhead line as we find it exemplified throughout our roads at the present time. Naturally, almost the first question that arises in one's mind as the subject is brought to notice is, Will the overhead line remain long a fixture, or must it give way to the underground conduit, or secondary battery propulsion? In answer to this we may safely say that for the great majority of our electric roads as individuals, the overhead line has come to stay, for many years at least. To the select few in wealthy and crowded cities we may answer that the overhead line is but temporary. To both classes, however, we will add, by way of warning, that it is economy to maintain the line in first-class condition at all times irrespective of what its future may be. In the larger cities we naturally expect to see iron poles in use, which are carefully set, so that there is practically no danger of their yielding from their positions after being once settled into place. In our smaller cities and across country we look for wooden poles, but we also expect to see these poles as carefully set and as straightly lined as are the iron poles in town. It is with regret, however, that I must say that our expectations are not as a rule fulfilled. Our roads care very little for the looks of things, and if a pole drops in three or four inches and another one slants out three or four inches, it does not matter so long as it still continues to hold the line in place or approximately in the centre of the track. If the line gets too much out of the centre they send the tower wagon along to take up on one of the eye bolts and slack away on the other until the line is again centred, provided the bolts are long enough to accomplish this. They would never think of digging the earth away and bringing the pole into proper position. Hence the array of poles along the line of a country road rather grates on the artistic sense. Now, this is a little matter, and while it does not apparently have much to do with the economy of the road, yet it has to do with it in a certain way, inasmuch as if a road endeavors to please its patrons by attention to these little things, and shows its good will, it will be much more heavily patronized than if things are allowed to go in a haphazard, ramshackle way, and if the patrons do not like the way things go they can do the next best thing and take it out in growling. I know of one road in the country whose cars are always fresh, neat and clean, and they have even gone to the expense of putting a mirror in the end of each car and a clock at one end. The result is that these cars are patronized more in proportion to the number of inhabitants than any other road in the country, the stockholders are pleased with the road, the patrons are pleased with it, and the general manager does not have a fight on his hands every day in the week.

As we go on further and take up the next thing, we find, for instance, on a certain road, that there are four or five different kinds of insulators, that some of the span wires are insulated from the posts and others are not. We also learn incidentally that the cars seem to be taking a great deal of current for their work, apparently requiring considerable more current than they should, and on a wet day fully one-third, if not one-half, more current is demanded than should be necessary. The question naturally arises, Whence occurs the necessity for this extra amount of current? One word explains the matter—"Leaks."

Leaks in the overhead line, leaks through the insulators to the span wire, leaks from the rail, it being poorly bonded and letting the current wander off to attack some neighboring water or gas pipe, and various things of this nature. Occasionally, too, we find a trolley wire breaking, the main cause of which is generally found to be too much slack between the spans. In regard to the condition of the line in this respect, there is nothing more detrimental to the line itself, and nothing which will cause more wear and tear on the trolley than having the line too slack.

The maximum sag of the line should certainly never exceed 18 inches on the hottest day in summer where the poles are set, as is customary, 45 to the mile, nor, on the other hand, does the line want to be pulled so taut that it will not have a sag of at least 7 inches on the coldest day in winter. If attempt is made to get it straighter than this latter, there is danger of its breaking on any slight further decrease in temperature. Of course, it is rather difficult to measure the dip of a line under ordinary circumstances, and it is, therefore, customary to determine the amount of sag by the eye, and to estimate the pull necessary to give the line at about 1,000 pounds, which is one-third the breaking strain, approximately, although in pulling up long lengths of wire, as, for instance, say one-half mile, it is customary to use a horse, and the strain on the wire near by approaches very nearly the breaking strain. This ultimately equalizes itself, so that there is a strain on the wire, under normal conditions when it is in good order, of about 500 pounds. With this amount the line should present a neat and taut appearance with a minimum amount of sag. Where 45 poles are used to the mile, the extra allowance in length of wire above the distance between the poles is about one foot per mile for a dip of one foot in the span; for a dip of 18 inches the extra length is two and one-fourth feet.

While as above the maximum dip is given as 18 inches, at the same time it should be understood clearly that a line with this dip presents a somewhat baggy appearance, and it is recommended that the line be pulled up so that the maximum dip during the hottest day in summer shall not exceed one foot. This brings the line in good shape and makes it always present a neat appearance, and the more the management of a road cultivate neatness in the appearance of their lines and equipment, the more liberally will their road be patronized, and the more will it tend to further the generation of a local pride in their street railway among the people of the town.

It is almost the universal custom at the present time to permit overhead lines to run along from week to week without being tested out for grounds, but it is not putting it too strongly to say that this is such rank folly that it has got to be stopped. There is absolutely no sense in generating surplus current to waste on running it into the ground through leakage from line, and therefore the matter of insulating the overhead line should receive the immediate and personal attention of the management of street railways. A new line complete so far as the material, labor, etc., are concerned, could be put up at a cost of about $700 per mile. Suppose we take the cost to a road using 1,500 amperes of current, whose line is in bad condition, so much so that on a rainy day one-third the current goes to waste; or, in other words, there is a leak of 500 amperes, which, at 500 volts pressure, is equivalent to 250,000 watts, or, reduced to horse power, is equal to 335 h. p. Suppose the station is consuming five pounds of coal per horse-power-hour. This is equivalent to a direct loss of three-fourths of a ton of coal per hour, to say nothing of the damage it is doing, or of the losses that occur in other ways, the running of the dynamo, waste of oil, depreciation of machinery and so on.

From this it may be seen that if a leaky line of this sort is allowed to remain in operation it will not take very long for it to burn out enough coal in waste to pay for a new line put up in first-class style. Therefore, I say to the management of roads, it is practical economy to employ a competent electrical engineer to organize an electrical department whose duty it shall be to look to the electric equipment in all its details, to manage it in the most careful and thorough manner, to make frequent tests and inspections of the overhead lines, as well as the tracks, power station, equipment, etc., to the end that they may all be maintained in the proper condition for good and serviceable work, so that the highest degree of true economy may be obtained.

(To be continued.)

A Street on Fire.

(From Our Special Correspondent in Budapest.)

A curious accident occurred here yesterday, in which the street was practically set on fire, the flames reaching higher than the houses. A glass carboy filled with benzine accidentally fell from the cart in which it was being hauled and broke, the benzine running over the street and through the slot into the conduit of the electric railroad. An electric car passed just at that time, and it appears that there was some sparking between the trolley and the conductor in the conduit; this lighted the benzine, which burned with an almost explosive violence. The car was stopped, and the frightened passengers dismounted through a sea of flame, while the car was being set on fire. The flames of the burning benzine reached as high as the tops of the houses, producing volumes of dense smoke, until it was all consumed, about ten minutes after it was lighted. With the exception of a slight injury to the car, no further damage was done.

BUDAPEST, Hungary, Sept. 15.

THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE.

(Compiled from the principal foreign electrical journals.)

BY CARL HERING.

ELECTRO PHYSICS.

Resistances at Low Temperature.—The "Phil. Mag." for September contains an article by Profs. Dewar and Fleming on the electrical resistance of metals and alloys at temperatures approaching the absolute zero; a full abstract is published in the Lond. "Elec.," Sept. 15. The paper is a description of their researches which were similar to but more extended than their previous series, particular attention being given to temperatures below — 100 degrees C.; owing to the fact that at such low temperatures air liquefies, as also for other reasons, the temperatures were measured by the change of resistance of a platinum wire, assuming the temperature coefficient to be constant; the temperatures are therefore given in what they call platinum degrees; they describe the preparation of metals and alloys and the method of measuring the diameters, the latter consisting in placing the wire, together with a standard gauge, in a sort of projecting microscope, magnifying it about 300 times, and then measuring both on the screen; they describe the way in which the resistance coils were made so that they could be placed in a bath of liquid gas; the resistances were measured with a Wheatstone bridge; about 50 coils in all were prepared and repeated measurements made of them, some sets requiring the consumption of several quarts of liquid oxygen; an interesting chart is given containing the curves for a number of metals and alloys, also tables giving the specific resistance and the temperature coefficient of a number of pure metals and alloys, all of which are contained in the abstract in the Lond. "Elec."; some of the curves are concaved upward and some concaved downward, those with the most marked curvatures being the magnetic metals nickel and iron; lines cross one another at low temperatures, thus changing their order of conductivity; at the lowest temperature reached the best conductor is pure copper, as the copper line crosses that for silver; in general the best conductors among the pure metals are those which are most sonorous, like silver, platinum, gold and copper; the results confirm the conclusions reached in their former paper, viz., that the resistance of pure metals will probably vanish at the absolute zero; all of the curves of the pure metals tend toward absolute zero, while all those of the alloys do not, but tend to pass above it.

High Frequency Discharges.—The "Phil. Mag." for September prints a note by Mr. Swinton, part of which was already noticed in the Digest Aug. 5 and 12. In addition, he describes the following experiment: A glass tube two feet long and two inches in diameter was exhausted like an incandescent lamp, and was wound outside with three turns of fine copper wire in the form of a spiral of coarse pitch, one end of which was connected to the high frequency coil, the other ends of both the coil and the wire were free; the wire became luminous, and a second bright blue spiral appeared inside the tube, exactly half way between the adjoining turns of the wire; the effect appears to be due to the violent repulsion of the molecules of residual air in the tube, and their bombardment on the other side.

Regarding the incandescence of lamps with high frequency currents, he describes the following experiment as a proof that the current must be considerably smaller than the continuous current to produce the same effect; the lamp was connected as usual, but the circuit was cut, a sheet of glass being introduced between the ends of the wire, thus forming a sort of condenser; sparks radiated about three inches from these points and the lamp became incandescent; as the capacity of that condenser must be exceedingly small, the quantity passing must be very minute; he also offers an explanation of the fact that if the heat be constant the quantity of electricity is inversely proportional to the mean volts during each impulse.

Heating of Condensers.—In an article by Mr. Kleiner in the "Weid. Ann.," vol. 50, p. 138, abstracted in the "Elek. Zeit.," Sept. 15, he finds from experiments that if the heat generated in a condenser made of tinfoil and ebonite be represented by 1, then for the same number of charges and discharges and with similar condensers, differing only in the dielectric, he obtains the following numbers: Paraffine, 0; colophon, 0; mica, 0.28; wax, 0.6; glass, 0.74; gutta-percha, 0.76, and rubber, 1.41; condensers with paraffine or colophon show an exceptionally short time for charging, it being from one to two seconds.

New Leyden Jar.—A novel form of Leyden jar, devised by Mr. Dopere, is described and illustrated in "La Lum. Elec.," July 22; it consists of a smooth closed glass tube, from which the air is exhausted to the same degree as in the Geissler tube; through one of the ends is fused a platinum wire communicating with the inside and connected on the outside to a knob; the other end of the tube is covered on the outside with tinfoil, forming only the metallic coating; even this coating can be omitted if the tube is used while held in the hand. An ordinary Geissler tube will also serve the purpose if care is taken to insulate one of the poles, the hand serving as the exterior coating. (An ordinary incandescent lamp is said to act in the same way).

Prof. Lodge's Electro-magnetic Hypothesis.—In the Lond. "Elec.," Sept. 29, Prof. Poynting gives the first part of a sort of review of Prof. Lodge's second edition of his "Modern Views of Electricity." In these articles Prof. Poynting makes a critical examination of Lodge's hypothesis, but in perfectly plain language and without going into mathematics; those who desire to have a brief résumé of Lodge's hypothesis in an easily understood form are recommended to read these articles.

Ether and Matter.—Dr. Lodge at the recent B. A. meeting described an experiment by passing a beam of light between two circular discs of steel revolving with great rapidity, from which he concludes that there is no mechanical connection between the ether and the matter which it may surround; that, in fact, the motion of gross matter does not set the environing ether in motion with it.

An Electric Charge.—Prof. Fitzgerald at the recent B. A. meeting defined an electric charge as follows: "Outside the charged body there is a stress in the ether; inside the charged body there is a stress in the matter; and the measure of the electric charge is simply the measure of the latter stress, the charge being located where one stress ends and the other begins."

Nature of Depolarizers.—The Lond. "Elec.," Sept. 15, reprints a note by Prof. Armstrong intended to supplement his former paper on this subject, abstracted in Digest July 27; it is intended to show that the argument there made use of in considering the dissolution of metals, such as magnesium in nitric acid, may be clearly understood and its consequences more fully realized.

Pressure in the Interior of Polarized Dielectrics.—In an article on this subject in "La Lum. Elec.," Sept. 23, Mr. Blondin gives a mathematical discussion, and concludes that Larmor, in his Royal Society paper (vol. 52, p. 53), does not give a conclusive argument in favor of Maxwell's theory.

Interference of Electric Waves.—"La Lum. Elec.," Sept. 16, continues its abstract of the article on this subject by Messrs. Sarasin and de La Rive; it is concluded in the issue of Sept. 23. One of their most important conclusions is that the velocity of propagation of electric waves is the same in air as in conducting wires.

Dispersion of Electricity by Daylight.—According to the Lond. "Elec. Rev.," Sept. 15, it appears, from recent investigations, that when metallic bodies bearing charges of electricity are exposed to the action of daylight, the quantity diminishes; this is especially the case with aluminum, but it has also been observed with brass, copper, zinc and cadmium; a polished surface seems to be an essential condition. A resume of observations is given by Mr. Bichat in the "Jour. de Physique" for 1889; other more recent articles on the same subject appeared in that journal, third series, vol. 1, page 557, and July, 1893.

Electrical Action of Light Upon Silver.—The Lond. "Elec.," Sept. 15, reprints an article on this subject, by Colonel Waterhouse, from the Journal of the Asiatic Society of Bengal; he describes briefly the experiments of Becquerel in 1839 and Minchin in 1880, following them with a description of his own, which confirm the results of the former, showing that no reversal of sign is produced by any of the colored rays, although in some cases the blue rays appear to have a reversing tendency; he gives the data for some of his experiments.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Low Resistance Standards.—The Lond. "Elec. Rev." and "Elec. Eng.," Sept. 29, publish a B. A. paper by Prof. Jones on low resistances from .001 to .0001 ohm; instead of measuring these by comparison he recommends measuring them directly by the Lorenz method, which, he says, seems in all its details to be the most accurate method; he describes the method briefly, as also the results of some tests made in measuring very low resistances; in this method the resistance is calculated from a coefficient of self-induction and a velocity of rotation (that is, a time); he believes that electricians have not realized the accuracy and ease with which absolute measurements of resistances may be made with a well constructed Lorenz apparatus; a tuning fork was not found to be accurate enough for measuring the time, and he therefore uses a recording chronograph and a standard clock; he recommends the construction of a Lorenz apparatus to be used at the National Laboratory, both for determining low resistances and to serve as a proper ultimate standard of electrical resistance; he believes that a coefficient of mutual induction, combined with a time, would afford a more satisfactory ultimate standard than any wire coils or than mercury columns.

Practical Standards.—The Lond. "Elec. Rev." and "Elec. Eng.," Sept. 29, publish a report of the Committee of the British Association on experiments for improving the construction of practical standards for electrical measurements; with the exception of the appendices, it is very short and contains little of any importance besides what has already been published. Appendix 1 gives a report made in November of last year to the Board of Trade, on electrical standards; it contains the resolutions regarding the standards, as also the specifications and descriptions for the ampère measurement and the preparation of the arc cell, all of which appear to be the same as those published in The Electrical World at that time.

In Appendix 2 Mr. Glazebrook describes some experiments with the effects of the heating produced in the coils by the currents used in testing; the results of several tests are given, one of them showing that a 100 ohm coil changed 0.006 ohm by trebling the current, that is by increasing it from .05 to .15 ampère; in conclusion he says that the effect of heating is small though appreciable when currents approaching .15 ampere are used.

The Chicago Congress.—The London "Elec.," Sept. 29 contains a well written article on the Electrical Congress at Chicago, by Prof. Silvanus P. Thompson; the report of the proceedings of the Chamber of Delegates is of particular interest, for, as it will be remembered, the sessions were held with closed doors, no reporters being admitted, and its proceedings, therefore, could not be reported in the electrical journals; being a delegate himself he has been able to give a very good report.

Curves of Alternating Currents.—Mr. Blondel, in "L'Ind. Elec.," Aug. 25, describes an analytical method for determining the curves of alternating currents, consisting essentially of a determination, by means of experiments, of the successive terms in the Fourier series, from which the equation of the curve, and therefore the curve itself, can be deduced; the terms are determined by means of auxiliary apparatus used in connection with the dynamo itself The Lond. "Elec. Rev.," Sept. 29, describes this method as follows: "It consists in passing the current to be analyzed through one coil of a dynamometer, and passing through the other coil a sine current, whose periodicity can be made an even number of times that of the first current; the reading of the dynamometer then will enable the amplitude of the corresponding component of the original current to be calculated"; it speaks of this as seeming to be the simplest method to employ.

Alternating Current Ammeter.—Mr. Preyer, in the "Zeit. fuer Elec.," Sept. 1, shows how the Thomson principle, of the repulsion of a piece of copper in an alternating magnetic field, can be applied to a measuring instrument. A horizontal copper cylinder is pivoted perpendicularly to the lines of force between the poles of two electromagnets through which the current to be measured passes; the cores of these magnets are made of laminated iron; inside of the cylinder the field is strengthened by inserting an iron core; encircling the copper cylinder is a fixed cylinder made of four equal quadrants, two of which are copper and two iron, those of like metals being diametrically opposite to each other; this is placed in the field so that the iron quadrants form a sort of pole piece to the electromagnets, but extend from the centre to one side only, thus resembling the poles of a dynamo from which one of the pole projections has been removed; the place of this one is taken by the copper segment; this arrangement of the iron pole piece and the copper segment causes the cylinder to tend to rotate about its axis, as is well known from the Thomson experiment; the copper contains a pointer and a counter-weight or spring which counteracts the torque produced. The deflecting force is said to be quite strong.

Registering Meters.—"L'Ind. Elec.," Aug. 10, publishes an illustrated description of a registering watt or volt meter, in which a number of objections to the usual forms of instruments are claimed to be overcome; it consists essentially of an electro-dynamometer with a long pointer, a revolving drum, and an electro-chronographic motor; the motor is like those used in the Frager meters, and its object is to revolve the drum at the rate of one revolution for every 26 hours, and also to press a needle on to the drum at regular intervals, thus making a series of dots, the needle ordinarily being above and not in contact with the drum, in order to allow it to move freely without friction or resistance, and without being interfered with by any imperfections in the paper covering the drum; even with rapidly varying currents as in railway circuits the curve obtained is said to be more reliable than the thick lined and very jagged curves produced by instruments giving a continuous curve; when used as a voltmeter the deflections are proportional to the square of the voltage, and therefore require specially ruled paper.

Coulombmeter.—"L'Ind. Elec.," Aug. 25, gives a fully illustrated description of the coulombmeter of Siemens & Halske, intended to measure and integrate the current delivered from the mains. It consists of a simple ampere meter like the well known Deprez "fishbone" ammeter, and a clock which at stated intervals brings the pointer back to zero, recording the angle through which the pointer has to be moved back; the sum of these angles is then proportional to the ampere-hours; a table of errors, as found by Prof. Weber, is given, showing that they are less than one per cent. for all but the smaller currents.

Meter Reading in Prices.—The "Elek. Zeit.," Sept. 15, states that a German firm recently brought out meters which, instead of reading in ampere or watt hours, give directly the price of the electricity consumed, thus enabling the consumer to read the meter himself intelligently; as such meters do not appear to be allowed in Germany, it is suggested that they be made with two scales, one reading in electrical units and the other in the money equivalent.

Meter.—"L'Elec.," Sept. 16, contains an illustrated description of the Routin meter, which has already been mentioned in the Digest, Sept. 2; it is favorably

commented upon, but the article appears to be on the order of a trade note.

Measuring Insulation Resistance.—The French apparatus mentioned in Digest, Sept. 23, is described and illustrated in the Lond. "Elec. Rev.," Sept. 15.

Electrometer.—The Lond. "Elec. Rev.," Sept. 15, reprints a brief description from the "Ann. der Phys. und Chem.," vol. 48, p. 726, of a new electrometer, by Mr. Christiansen, accompanied by a good illustration; between two vertical parallel condenser plates is suspended a double plate made of zinc and carbon, insulated from each other by mica, one connected to the upper, and one to the lower suspension wire; the suspended plates carry a small mirror; 100 volts on the outside plates and one volt on the inside plates produce a measurable twisting of the suspension wires; dimensions, and a formula are included in the description.

Photometer.—"La Lum. Elec.," Sept. 23, mentions a photometer, devised by Mr. Simonoff, consisting of a book containing 24 pages, each of which is tinted slightly darker than the preceding, and on each of which are printed letters of different dimensions; to measure approximately the illumination at any place the pages are turned until it is impossible to read the type. (Such a photometer, based on absolute instead of relative illuminations, depends upon the eyesight of the observer, and can, therefore, be considered only as a very crude instrument.)

A Method of Observing Rotations.—Prof. Fitzgerald in the Lond. "Elec.," Sept. 20, describes very briefly some methods of observing rotations by means of interference fringes.

DYNAMOS AND MOTORS.

Very Small Motors.—In "L'Elec.," Sept. 23, Mr. Meylan discusses the subject of very small electric motors, and gives the results of an intelligently made test of a motor designed by himself, intended to develop a power of about 0.02 foot-pound per second (about 0.03 watt) on an axle turning four or five times a minute, and intended to be run with a few primary batteries at 6 to 8 volts and 0.2 ampère; the motor is only briefly described; the field is made of permanent magnets, because the loss in the windings of an electromagnet becomes relatively very great in small motors; the armature is relatively large, being 3 cm. in diameter and 5.5 cm. in length, weighing only 90 grams; it is drum wound, and has a five point commutator; the resistance of the armature is 17 ohms. In the tests a Prony brake could not be used on account of the difficulty in measuring the speed; the method used for measuring the power was to let the motor raise a weight, tied to a silk string which is wound on the shaft; detailed results of the tests are given, from which we extract the following: with 3.5 volts and 0.136 ampère, the electrical efficiency was 33.7 per cent., the total efficiency 20.2 per cent., the mechanical power developed .096 watt, the speed being 594 revolutions per minute; the power lost in friction, hysteresis and Foucault currents was .064 watt. In another test the figures were as follows: 5.30 volts, 0.164 ampère, speed 1,100, useful power developed .214 watt, electrical efficiency 44.5 per cent., total efficiency 24.7 per cent.; the loss in the motor is .174 watt. Without a load it ran at a speed of 1,320 with 3.64 volts and 0.052 ampère. He also calculates the work lost per revolution in each case, which averages about 70,000 ergs, but varies quite a little; he gives some formulæ from which he calculates that the maximum power would be obtained at a speed of 2,000 revolutions, with 9.3 volts and 0.3 ampère at which the efficiency would be 36.5 per cent.; such a result would be impossible with a field produced by electromagnets.

Self-Exciting Armatures and Compensators.—The Lond. "Elec.," Sept. 22, publishes a paper read at the recent B. A. meeting by Mr. Sayers, describing his self exciting armatures for continuous current dynamos, and compensators for loss of pressure in feeders. The arrangement is the same as that described in Mr. Sayers' paper before the Institution of Electrical Engineers (see Digest, June 10, 17, July 1, Sept. 16). Several of the cuts given are of interest. Mr. Swinburne pointed out that with this device a motor can be designed having no winding whatever on the main moving part, which would be simply a mass of iron; this would involve the use of revolving brushes, but as there would be no necessity of shifting the diameter of commutation with varying loads, there would be no objection to this; such a motor might be used with advantage for railway work.

Suppression of Sparking.—In "L'Ind. Elec.," Aug. 25, Mr. Picou describes the recent improvements of Mr. Sayers, already fully described in these columns; he includes a cut showing the arrangement better than those published lately in the English papers, as also two diagrams, one of a Sayer and one of a Hopkinson dynamo of the same output, showing how much smaller the former is. "La Lum. Elec.," Sept. 16, reprints the discussion of Mr. Sayers' paper, more fully than was given in the former issues of the English papers, and including a number of diagrams which did not appear in these. The full record of the discussion is contained in the "Jour. Inst. E. E." for July.

Output as a Function of Size.—The "Elek. Zeit.," Sept. 15, publishes a second article by Mr. Schulz on this subject (see Digest of last week), in which he considers the subject of multipolar machines; he limits himself to those without teeth on the armature, and shows that in general machines of the same dimensions will give the same output whether they are bipolar or multipolar, assuming that the armature relations are the same; he shows that this is true at low as well as at equal speeds.

Automatic Regulators for Dynamos.—In "L'Ind. Elec.," Sept. 10, Mr. Picou, in a short article, discusses the subject of automatic regulators for keeping the voltage of a continuous current dynamo constant, deducing some mathematical expressions intended to aid the designer in their construction; he develops a law for the variation of the current and the electromotive force during the variable period between the change and the subsequent regulation of the apparatus.

TRANSFORMERS.

A Subdivided Transformer.—Under this heading the Lond. "Elec.," Sept. 29, publishes a brief illustrated description of a 300 watt transformer for 100 volt circuits, from which any voltage from 1 to 200 can be obtained; the windings are subdivided, the terminals being brought to a series of binding posts; for obtaining from 100 to 200 the primary circuit is put in series with the secondary, which can be done, as their phases are opposed; any portion of the secondary can be connected so as to oppose the primary; the whole transformer is only about 5.5 inches in diameter.

ARC AND INCANDESCENT LIGHTS.

Forcing Incandescent Lamps.—Prof. Ayrton, in an interesting article entitled "New Lamps from Old," in the London "Elec.," Sept. 29, shows, by means of calculations based on tests made by himself, that it is more economical to run lamps at a higher voltage than that for which they are made; in a long series of carefully made tests he ran 100-volt lamps at 100, 102 and 104 volts, and finds that a very considerable increase in the light is obtained and a marked diminution in the watts per candle during the first 100 hours; the experiments were made with Edison-Swan lamps, which, he says, have been so modified that the small hump, which occurs in their curve after many hundred hours, is greatly magnified and made to occur in the beginning of the life curve, the filaments being made of bamboo and flashed by the wet process; in view of the recent reduction in the price of lamps in England, he says that it is very important to use higher voltages in the future to obtain maximum economy; (the same conclusion was reached in another way in a recent Institute paper by the compiler.) A 100-volt 8 c. p. lamp will average 7.5 c. p. for 600 hours with 42 watts; at 12 cents per kw.-hour the cost of 100 candle-hours will be 7.64 cents; as the light varies as the seventh power of the voltage, this lamp run at 104 volts will average say, 10.5 c. p. for 200 hours with an expenditure of 44 watts; the cost of 100 candle-hours (the paper says "lamp-hours," but it is evident that "candle-hours" is meant) for the same 600 hours will be 7.02 cents, or about 9 per cent. less; when the energy costs more, the saving will evidently be greater; from this he concludes that especially when the energy is expensive, higher voltages should be used, or in other words a consumer should order lamps marked for a lower voltage; instead of 8 and 16 c. p. lamps at 100 volts, he suggests ordering 6.5 and 13 c. p. lamps at 97 volts.

He also discusses the relative costs of lighting by electricity and gas, giving the results of carefully made tests with the gas burners, the electric lamp being forced as described above; with the cost of gas at 75 cents per 1,000 cu. ft., he finds that the electric light is less than with Bray's street lamp governed burner, and much less than with cheap ungoverned burners, but not as cheap as with Sugg's governed table top burners, nor not nearly as cheap as with Sugg's Argand burners, if the pressure does not fall below .7 inch of water.

Candle Power of Search Lights.—Prof. Silvanus Thompson criticises the way in which the candle power of search lights is given, as for instance 240 millions, stating that it is well known that an arc light of even one million candle power would require nearly a square foot of crater area. (One of the makers of search lights stated to the compiler that the method of calculating their candle power was as follows: Assuming that the brightness at every portion of the reflector was equal to that of the crater; the total light emitted from the reflector is equal to that from the crater multiplied by the ratio of the area of the mirror to the area of the crater; or, in other words, every square inch of the reflector emits as much light as a square inch of crater; this may be approximately correct, but it is nevertheless misleading to give the power of the search light in candle powers without some qualifications, for such rays are all parallel, and the light does not follow the inverse square law; to measure it with a photometer, therefore, applying this law, is absurd unless qualified; to state that at the distance of one mile it gives the equivalent of a certain candle power would be quite correct, but to state that, therefore, at half a mile the light would be four times as great would be absurd, as the rays are nearly parallel, suffering only a small loss from dispersion and absorption.)

Air Pump.—In the Lond. "Elec.," Sept. 29, Prof. J. J. Thomson describes a vacuum pump which can be worked either automatically or by hand, and in which the working liquid may be sulphuric acid, mercury, or any liquid having a small vapor pressure; the article is a paper read at the recent B. A. meeting; the construction of the pump is clearly shown in a cut; the liquid in the pump is raised by means of a water pump, and all that it is necessary to do is to turn a three-way cock at the proper time; this operation may be performed automatically by turning the cock by the aid of two electro-magnets, one for each of the two motions, the circuits of the magnets being closed by floats in the pump itself on the upper and lower levels of the liquid, which floats on rising connect two platinum wires fused through the glass and terminating in the inside of the tubes of the pump.

Incandescent Lamp Manufacture.—In his serial in the Lond. "Elec.," Sept. 22, Mr. Ram continues the subject of the exhaustion of the bulbs, giving a number of practical hints. In the issue of Sept. 29, he describes the induction coil test for the vacuum, and the photometric measurements of the lamps, including a method by which the lamps are all brought to the same temperature; that is, to the same efficiency in watts per candle, which is evidently the most rational way of sorting lamps.

Incandescent Arc Lamp.—Mr. Salomons in a letter to the Lond. "Elec. Rev.," Sept. 29, states that a similar result to that obtained by Mr. Marks, in his recent paper, may be obtained by surrounding the incandescent ends of the carbon with a flame from an Argand burner supplied with gas; with this all the advantages of the inclosed glass bulb are obtained; arc lamps of the worst construction and with inferior carbons will then burn with great steadiness; the device is not patented.

TRANSMISSION OF POWER.

Transmission of Power.—The Lond. "Elec. Rev.," Sept. 29, publishes an abstract of all of Prof. Unwin's Howard lectures (see "Digest" of last week) on the development and transmission of power from central stations; considerable data is given regarding the efficiency of steam engines, coal consumption and the cost of steam power, based on English prices. The full report of his first lecture is continued in the Lond. "Elec. Eng.," Sept. 29.

Series Transmission.—The "Jour. of the Inst. Elec. Eng.," for July, contains a paper by Mr. Golchot, giving quite a complete description, accompanied by illustrations, of the transmission and distribution at Genoa, in which, as will be remembered, continuous currents are used, all the dynamos and motors being in series, the current being constant, and the voltage variable; there are three generating stations, named the Galvani, Volta and Pacinotti, situated one above the other along the same river, from which the power is taken. These stations have already been described, but the present paper contains probably the best and most recent description.

Wynau.—According to "La Lum. Elec.," Sept. 16, there is a project to utilize a 2,000-h. p. waterfall at Wynau, Switzerland, and to transmit some of it by compressed air up to a distance of three miles, and beyond, up to a distance of 12 miles, by means of electricity, at 8,000 volts alternating; the air compressors will have a capacity of 2,500 cubic metres per hour at eight atmospheres; the price for one h. p. for 3,000 hours per year will be $120; for 200 h. p., $35 each, for both the electric and the pneumatic transmission; compressed air will be sold at one-fifth of a cent per cubic metre per hour, and one-half of this for over 10 cubic metres; 1,200 h. p. have already been engaged.

Locle.—"La Lum. Elec.," July 22, publishes the conditions for competitive proposals for utilizing the water power of the river Reuss and transmitting the power to Locle and Chaux-de-Fonds.

ELECTRIC RAILWAYS.

Power for Electric Railways.—Mr. Lea, in the Lond. "Elec. Eng.," Sept. 22, discusses the subject of purchasing the current for railways from existing lighting stations, but gives nothing new; he concludes that in any case the cost would exceed that incurred by putting down a special plant for the purpose, but appears to favor the reverse, viz., the advisability of a railway power station selling their power for lighting purposes.

Railway Return Leads.—According to the Lond. "Elec.," Sept. 29, Lord Churchill proposes to employ a buried insulated conductor, and at about every 20 feet to erect a special contact piece above the roadway; the car carries a brush which is always long enough to touch one of these contacts (unless this circuit is earthed, however, dangerously great shocks could be obtained by horses and pedestrians, but if earthed there appears to be little or no advantage in the arrangement).

Railway Motor.—For a curious form of motor containing no windings on the revolving part, see a paragraph above on self-exciting armatures.

High Speed Railroading.—"L'Elec.," Sept. 23, gives an abstract of the article by Mr. Behr already noticed in the Digest Oct. 7. It appears to be the intention of the promoters to construct these express lines as an adjunct to existing steam railways; at these speeds, of 120 to 150 miles per hour, the time from New York to Chicago would be reduced to about seven and a half and six hours respectively.

Electric Railway at Remscheid.—The "Elek. Echo," Sept. 16, publishes a description of this road, including a large plate of the profile, an interior view of the generating station and a view of a portion of the line.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Electric Light from Town Refuse.—The Lond. "Elec. Eng.," Sept. 29, reprints in full a British Association paper by Mr. Keep, in which he endeavors to show that it is not only practicable but economical to light cities or towns, in whole or in part, by burning its refuse; an essential part of his plan is the use of Mr. Halpin's system of thermal storage; in the appendix the data is deduced for such a station; in his figures he states that at Warrington the

average evaporative power of the refuse throughou tthe year is 1.7 lbs. of water per pound of refuse, and that it varies from about two in winter to about one in summer.

Power from Town Refuse.—The Lond. "Elec. Rev.,' Sept. 29, prints an abstract from a B. A. paper by Mr. Warner, containing some figures obtained from destructors; it appears that a pound of coal has 42 times the value of a pound of refuse for generating power; at Oldham the horse power is given at 50 for six cells, or about 46 lbs. of refuse per horse power hour; he states that "it will be seen from these figures that we cannot look forward to a large amount of power for electric lighting, and it is even questionable if the power generated could be usefully adopted for that purpose. . . . Electric light produced by burning refuse can only show economical results in very exceptional cases."

Power from Town Refuse.—Mr. Tomlinson's serial is continued in the Lond "Elec. Rev.," Sept. 29; in it he gives more results obtained from destructors in regard to their use for power.

Storage of Energy.—At the recent B. A. meeting the president of one of the sections suggested that instead of inefficient chemical storage cells it might be better to use the dynamos to decompose water and compress hydrogen and oxygen in steel cylinders at great pressure. (But what is to be done with these compressed gases?)

Distribution.—Mr. Guy, in his serial in the Lond. "Elec. Eng.," Sept. 29, discusses the subject of three and five wire distribution.

WIRES, WIRING AND CONDUITS.

Distribution of Current in Networks of Conductors.—The "Elek. Zeit.," Sept. 15, publishes an article by Mr. Teichmueller, in which he gives some simple formulas and rules for calculating the current and the fall of potential in a system of interconnected conductors; that is, conductors without ends, as for instance the mains in systems of low tension distribution; the article is not of a nature to admit of being abstracted here.

House Wiring.—The "Elek. Zeit.," Sept. 22, describes and illustrates a number of improvements in the novel system of wiring devised by Mr. Peschel, mentioned in the Digest June 17 and Sept. 23; most of the illustrations explain themselves.

Submarine Cable Grapnel.—The Lond. "Elec. Rev.," Sept. 22, illustrates a new form of grapnel, the chief feature of which is that the pivoted toes are held by a pin which gives way and thereby releases the toe when the strain exceeds a certain predetermined amount.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Signaling through Space.—In the Lond. "Elec.," Sept. 29, Mr. Smith discusses the recent Congress paper of Mr. Preece, and points out the similarity between Preece's experiment and those of the late Willoughby Smith at the same time showing that both results are equally due to conduction; he also describes briefly the experiments at the Needles lighthouse, in which the current passes through the water from a submerged end of a cable; by this means communication was obtained through a gap of water of 60 yards, for which two or three Leclanché cells were ample; he thinks this method well suited for coast defenses.

Interlocking Railway Systems.—In a paper by Mr. Hubou, in the "Memoirs of the Soc. des Ingenieurs Civils," of July, a number of electrical systems are described and compared with mechanical and hydraulic systems.

Telegraphy in Brazil and in the East Indies.—The "Jour. Telegraphique," Aug. 25, describes and gives some statistics of the telegraph in these countries.

Telephone Statistics of Switzerland—The "Elek. Zeit.," Sept. 15, publishes a brief summary of the statistics for 1892.

Transmarinephone.—A correspondent of the Lond. "Elec. Eng.," Sept. 22, describes, in the style of a daily newspaper article, an instrument by this name, for telephoning from London to New York and Australia; the description is very vague.

Telegraph Switchboard.—"L'Elec.," Sept. 23, contains the first part of an illustrated description of the Mandroux switchboard.

ELECTRO-CHEMISTRY.

Hellesen Dry Cell.—"La Lum. Elec.," Sept. 23, gives a short description of this cell, accompanied by a vertical section.

Researches with the Leclanché Cell.—The Lond. "Elec. Rev.," Sept. 15, gives an abstract of the researches of Mr. Ditte (Comptes Rendus, vol. 116, pp. 812-815), already mentioned in these columns.

Zinc Electrodes.—The "Jour. of the Inst. of Elec. Engineers" for July, in its abstracts mentions the Moseley process of making zinc electrodes; thin sheet zinc is first amalgamated and then rolled into the desired shape; tubes fitting into each other are also used; on account of the purity and homogeneity of the zinc so prepared, there is said to be no local action.

Porous Lead for Accumulators.—The "Jour. of the Inst. of Elec. Engineers" for July mentions in its abstracts the Correns process (the prime object of which is presumably to evade the Faure patents); the lead grid is filled with a mixture of lead salts, sulphuric acid and gelatine, and is treated as an anode in a bath of sulphuric acid, the cathode being of carbon covered with mercury; this converts the material into lead amalgamate, which is then used to fill lead grids in the usual manner.

Heating of Secondary Batteries.—The "Elek. Zeit.," Sept. 15, gives a brief note on this subject from Wied. Ann., Vol. 49, No. 7, describing tests made with the object of determining the theory of accumulators.

MISCELLANEOUS.

Electrical Papers at the Recent B. A. Meeting.—The Lond. "Elec.," Sept 22, publishes a complete list of the electrical papers read at the recent B. A. meeting; most of these are of a purely scientific or mathematical nature, and only a few of them have been noticed in the electrical journals. It also gives a report of the proceedings, including a very short outline of each paper and the discussion therein. Dr. Howard, in the Lond. "Elec. Eng.," Sept. 29, gives a brief summary of all the electrical papers read before Section A.

Death by Lightning.—According to the Lond. "Elec. Eng.," Sept. 22, statistics show that in France, between 1835 and 1883, the number of deaths caused by lightning average 100 annually; the number of those struck, but not fatally, is about five times as great; the scorching produced on the bodies sometimes assumes an almost artistic configuration, which is often incorrectly reported as reproductions of the images of trees.

Electrical Determination of Solubility.—The Lond. "Elec.," Sept. 8, mentions briefly an apparently successful attempt by Mr. Holleman to compute the solubility of so-called insoluble salts from the electrical conductivity of their solutions; this conductivity is proportional to the number of ions and hence to the quantity of salt present; a few figures are given for some insoluble salts.

Disinfection of Sewage.—The English journals of Sept. 22 mention a new system which is being tested in London, which is specially adapted to the drainage of seaside cities; sea water is electrolized, making it a powerful disinfectant, which is then pumped into sewers, thus destroying organic germs contained therein.

Aiming Cannon at Night.—In "L'Elec.," Sept. 16, Mr. Leroy describes a method devised by himself for aiming cannon at night by the aid of electricity.

Electric Advertising Letters.—The Lond. "Elec. Rev.," Sept. 22, describes letters for advertising purposes recently brought out in London, formed of a bright plated metal backing, having a hollow section like half of a hollow cylinder, into which are placed cylindrical glass tube lamps; the effect is said to be very attractive.

Graphical Methods.—The Lond. "Elec.," Sept. 22, reprints a report made at the British Association by the Committee on the Development of Graphical Methods in Mechanical Science, which constitutes a third report of that committee.

Parsons Regulator.—"La Lum. Elec.," Sept. 23, gives an illustrated description of this regulator, as used with the Parsons steam turbines.

Smoke Prevention.—The Lond. "Elec. Rev.," Sept. 15, contains an article by Mr. Booth on this subject.

Laboratory.—In the "Bul. de la Soc. Int." for July, Mr. de Nerville describes the interior arrangements of the laboratory which is under the auspices of that society, and which forms probably the best existing laboratory for general testing and researches.

Landmarks in the History of Electricity.—Mr. Gee begins a historical article on this subject in the Lond. "Elec.," Sept. 8.

Exhibitions.—The Lond. "Elec.," Sept. 22, states that it is proposed to hold an international electrical exhibition in Geneva in 1896. It also announces that a French official journal has published a decree organizing the Paris Universal Exhibition of 1900.

The Chamber of Delegates of the International Electrical Congress.

In the London *Electrician* of Sept. 29 Prof. S. P. Thompson has an article on the recent International Electrical Congress at Chicago, from which we extract the following, giving the first account that has yet appeared of the proceedings of the Chamber of Delegates:

The Chamber of Delegates, under the presidency of Prof. Rowland, of Baltimore, met usually in the afternoons. It set to work first upon ratifying the fundamental electrical units in such form as to meet with international agreement. There was little dissension as to the actual end to be arrived, but much discussion as to the form. After it had been agreed to adopt as the international standard of resistance the mercury-column ohm, 106.3 centimetres in length, there arose a prolonged wrangle as to whether this should be taken as a primary standard or not. Prof. Mascart desired that this material standard should be decreed to be the ohm without any reference to the centimetre gramme-second system of units from which it is supposed to be derived, just as the international metre is defined as a certain bar of platinum without reference to its supposed relation to the quadrant of the earth's meridianal circumference. On the other hand, Prof. Mendenhall strongly urged that the abstract definition as 10^9 in the C. G. S. system should be retained. Eventually, by the appointment of a small sub-committee to settle the wording, a compromise was arrived at which leaves the definition in entire accordance with that already accepted in England, Germany and France. Similarly with the definitions of the ampere and the volt, compromises were finally voted with unanimity. It was curious to note that M. Mascart, who had stood out on the ohm as the champion of the material standard, advocated equally succinctly the definition of the ampere as an abstract unit without reference to any material way of reproducing it, whether by silver deposit or by some standard gravitational ampere-meter or electro-dynamometer. M. Mascart denied the precision of the silver deposit, and was supported by His Excellency Von Helmholtz, Profs. Carhart and Rowland equally impugned the possibility of getting an absolute reading correct to 1 part in 10,000 by either electro-dynamometer or by tangent-galvanometer, unless in some special research of extraordinary precision. Then the question was raised whether, supposing the ampere should be defined only in terms of the ohm and volt, the latter could be more accurately defined in terms of absolute value than the ampere could be. It was urged that Clark's cells could be made easily to agree to within 1 part in 10,000 to one another. On the other hand, it was doubted whether the absolute value of the cells so agreeing with one another was determined with anything like that accuracy. It was pointed out that the congress of 1881 defined first the ohm, then the volt, and took the ampere as the mere sequence of these two. Was it well now to reverse the order, and define the ohm and then the ampere, leaving the volt to be defined in terms of that pair of units? Of course in the abstract relations of the C. G. S. system the order was immaterial; but M. Mascart's proposition was to define the ohm in the concrete and the ampere in the abstract; which would necessitate a definition of the volt as that electromotive force which would send the abstract ampere through the concrete ohm. Eventually these matters were referred, as the ohm had been, to the small subcommittee to frame language; and its report, moved by Prof. Mendenhall, and seconded by Dr. Budde, was unanimously adopted. It defines each of the units as an abstract quantity, but adds in each case the practical standard by which in the present state of science the unit may be sufficiently closely represented for legal purposes. To distinguish these units as now defined from the definitions given by previous meetings or congresses, they are denominated the "international" ohm, the "international" ampere, etc. The wording of the schedules in which are to be described the details of the processes of silver-deposit, for the ampere, and of construction of Clark's cells, was relegated to a subcommittee consisting of Prof. Von Helmholtz, Prof. Carhart and Prof. Ayrton. The definitions of the farad, the coulomb, the joule and the watt were accepted without much debate as the logical consequence of the three units first decided. Over the proposal to recognize the "henry" as the unit of self-induction there was much discussion. Everybody appeared to be willing to agree to the proposal to adopt the name of "henry" (in honor of Prof. Joseph Henry) in place of the impersonal (and incorrect) name of "quadrant," selected by the Congress of 1889; but no one seemed to be quite ready to define the quantity to which the name was to be attached. It was pointed out that mutual induction must be expressed in terms of the same unit as self-induction. Eventually, an understanding was arrived at. M. Mascart moved, and Prof. Ayrton seconded, the adoption of the name "henry," while the exact definition was referred to the sub-committee. The new definition of induction cleverly turns the difficulty that is involved in any attempt to take into account the magnetic properties of the medium, and reconciles the two opposing views. Then came up for discussion the question of the proposed magnetic units. Should the C. G. S. system simply be adopted? or should a "practical" magnetic system be approved having the 10^8 as a factor in it to correspond to the volt? And what should be the names given to such units? Prof. Rowland objected to any extension of the "practical" system with its eighth and ninth-power exponents, into the magnetic part of the subject; urging, as one reason, that the designers of electromagnetic apparatus do not use anything except the C. G. S. system. He also objected to multiplicity of names. Some attempt was made to secure the adoption of the name of "gauss" for the C. G. S. unit of magnetic field, it being alleged that for want of some such name incorrect designations were sometimes given; as, for example, where the horizontal component of the earth's field is described as being 0.18 dyne. A majority of the delegates failed to see the force of this argument. It was moved by Mr. Siemens, and seconded by Prof. Nichols, that the C. G. S. units of magnetism be adopted without names, and this was carried. The question of the scientific designation of the brightness of electric lamps was then introduced. What was a 2,000-c.p. lamp? Was it one that only measured 2,000 in one particular direction? It appeared that certain American contractors, not of the first rank, had been in the habit of describing a certain kind of arc lamps as of 2,000 c. p. which in fact was far from being such. The law being apparently powerless to deal with such frauds in the absence of any recognized definition of candle-power, decision was asked on the point. It was suggested that lamps should be defined in terms of watts, not of candle-power. American delegates protested that this would not protect the consumer from having imposed upon him an inferior lamp, which, for the same number of watts, gave less candle power. It was pointed out that under the British Electric Lighting Acts the undertaker cannot prescribe to the consumer what sort of lamp he must use, and leaves the consumer free to use any lamp that is adapted to the declared pressure or current. It was eventually decided that, the difficulty being purely national and not an international one, arising entirely out of the circumstance that American municipalities have not yet adopted the wholesome practice of calling in some responsible consulting engineer to advise them upon the terms in which their contracts should be drawn up, the congress could not interfere. But the discussion served to emphasize the uncertainties which exist in the absence of working methods of measuring color and of a suitable integrating photometer.

Two other questions which were referred by the chamber to the subcommittees received anxious consideration, and were keenly discussed before being reported upon. One of these was the proposal for a system of uniform notation; the other related to the standard of light. The array of symbols proposed by M. Hospitalier was championed by him with ability and eagerness, and was with some amendments adopted by the sub committee and received by the chamber (but not for official adoption) and ordered to be printed. Some of its details seem open to severe criticism, but if only they could be universally adopted how convenient they would be! The proposal of Drs. Buude and Lummer to adopt as a standard of light the Von Hefner lamp, with its reddish flame of acetate of amyl, was no less emphatically urged. There was no other practical lamp of equal constancy—within two per cent—and the molten platinum standard was not realizable; then why not adopt it as *the* standard? It required much backbone on the part of English, French and Swiss representatives to resist the vehement plea. But, with the possibility of a simple and better electric standard coming in the near distance, giving a really *white* light of fixed brightness as a standard, it was clear that no proposal for a flame standard would be acceptable, and certainly not this amyl-acetate flame, however excellent may have been the results obtained at the Reichsanstalt. And so the subcommittee, under the presidency of M. Violle, arrived at the inconsequent conclusion that they were not able to report in favor of any standard at present.

Transformer Testing.

BY HENRY H. NORRIS.

As the transmission of power by alternating currents has come to occupy so important a place in the electrical industry, any consideration of its details must be of importance in studying the subject.*

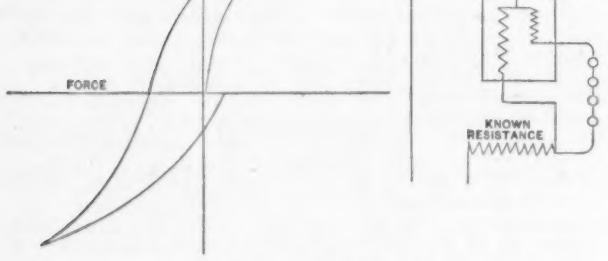
The purpose of this paper is to consider the various methods of testing transformers, both in the workshop and laboratory, so that we may know the best method to use in whatever circumstances we are placed.

The transformer itself is one of the simplest devices used in electrical work, consisting of two coils wound around a block of iron as near together as possible, and with the smallest amount of iron necessary to carry a given induction and laminated to break up eddy currents.

Before building a transformer the losses which will occur in it may be calculated approximately and the efficiency thus arrived at. These losses are: (a) $C^2 R$ in the wire, (b), hysteresis, and (c) eddy currents in the iron.

As it is necessary to keep the temperature of the iron and wire below a certain point in order to save the insulation, the heat generated must not be more than can be easily radiated by the surface exposed to the air. This surface should be from 1.75 square inches to 2 square inches per watt radiated. In small transformers this loss may amount to four or five per cent. of the energy transformed at full load, but in large transformers where the surface is proportionately less must not exceed one or two per cent.

The greatest loss which will occur in the transformer is that due to hysteresis in the iron. This loss depends on (a) the amount of iron in the core, (b) the induction per unit area and (c) the number of reversals of magnetism per second. To be exact, the loss must be determined experimentally, but careful experiments have been performed and results tabulated which answer well enough in preliminary calculations. The effect of hysteresis can be shown graphically by tracing the curve between the induction ($\mathfrak{B}$) and the force ($\mathfrak{H}$) for a complete cycle.† (See Fig. 1.) The area of the closed curve will give a measure of



Figs. 1 and 3.

the loss. Steinmetz gives an experimental formula which is nearly correct:

$$W = y \mathfrak{B}^{1.6};$$

where y is a quantity depending on the permeability of the iron, W is the loss in watts and $\mathfrak{B}$ is the induction per square centimetre.

The eddy current losses are not, as a rule, as important as the hysteresis and they may be decreased by laminating the core perpendicular to the direction of the current Mechanical difficulties prevent the iron from being less than .012 inch in thickness, and another consideration is that when the iron is made too thin the space taken by the insulation is too great in proportion, so that the eddy current loss cannot be entirely eliminated. The eddy currents vary with the current in the coils and the loss can be calculated on knowing the induction per unit area, the reversals per second and the thickness of the iron.

The formula is, practically,

$$W = x^2 \mathfrak{B}^2 n^2 10^{-16}.$$

Where W is the watts lost, x the thickness of iron in mils, $\mathfrak{B}$ the induction per square centemetre, and n the number of reversals per second.

Another item which is important and which may be calculated before building, is the current which will be taken when the secondary circuit is open. In actual work this current flows all the time and is dead loss to the station. The true or all-day efficiency takes this magnetizing current or leakage into account. All-day efficiency is the ratio between the total watt hours taken from and those given to the transformer. This is best measured by placing a Thomson recording wattmeter in both the primary and secondary circuits and letting them run for a number of days, so as to get the mean amount of current used.

These preliminary calculations will show the proper proportions for the transformer. It is well to draw a curve between efficiency and load which can be compared with the actual tests as well as with the curves of other transformers ‡

In testing any device much time will be saved by using system. The first thing to be done, therefore, is to decide what measurements are needed, which in the case in hand are as follows:*

1. Temperature at full load.
2. Efficiency at all loads.
3. Lag between primary electromotive force and current.
4. Lag between primary and secondary currents.
5. Mechanical design.

(a) Convenience in removing and replacing coils.
(b) Ventilation.
(c) Ease and safety in replacing fuses.

After all these preliminary details have been examined the transformer is ready to be tested electrically, and the first point of interest is in seeing that the heating losses agree with the calculations.

The question of the proper temperature for the transformer is a matter of judgment. Some makers allow a high temperature and ventilate and insulate accordingly, while others prefer low temperatures and less risk of burning out.

The first thing to do, then, is to put the primary terminals across the circuit, to load the secondary to its full capacity and wait until the temperature becomes stationary. If this temperature is within reasonable limits, the efficiency should then be examined.

Before making any measurements the reliable instruments for use with alternating currents may be mentioned.

For measuring potential difference the best instruments are: (a) Hot wire voltmeters (Cardew's and Queen's): electro-static voltmeters (Thomson's, Swinburne's, Ayrton and Mather's and Carhart's); voltmeters on the principle of the electro-dynamometer (Weston's).

For measuring current: electro-dynamometers (Siemens'); the attraction between two wires carrying a current (Thomson's balance) and the fall of potential through a known non-inductive resistance can be used.

A wattmeter for measuring the power given to a circuit can be made by using the fine wire coil of a Siemens dynamometer for the voltmeter having in circuit with it a large non-inductive resistance to decrease its self-induction, and at the same time allowing the current to flow through the movable coil.

A modification of this dynamometer was devised by Dr. Louis Duncan.† Here the movable coil is suspended by a silk fibre, and controlled by two palladium springs, which also serve to carry the current. A mica vane at the bottom dips into glycerine, and serves to damp the vibrations. The zero on this instrument remains absolutely constant, and the motion of the coil is "dead beat."

One of the first questions asked about a transformer, as about any machine, is its efficiency,‡ and this can be measured in many ways. A very useful and practical method is that used by Dr. Fleming in his recent tests, and called by him the "dynamometer-wattmeter method."‖ The connections are shown in Fig. 2.

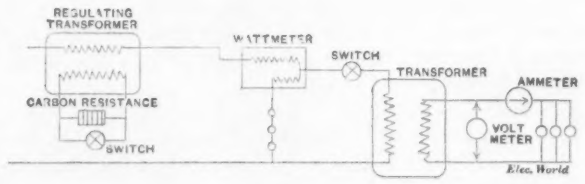


Fig. 2.

In this case a dynamometer is used as a wattmeter, as mentioned above. This is calibrated best by putting the heavy coil in series with a known non-inductive resistance, while the fine coil is connected across its terminals with the non-inductive resistance, L, in circuit (see Fig. 3). By varying the current a calibration curve can be drawn and the wattmeter is ready for use.

Having calibrated the wattmeter the secondary is connected through an ammeter to a load of lamps. A voltmeter across the secondary terminals and the wattmeter in the primary circuit will complete the connections.

It may be necessary to vary the primary current so that the fall of potential through the primary be kept constant. This can be done by sending the primary current through the primary coil of another transformer. In the secondary circuit of this is a variable non-inductive resistance, by varying which the secondary current will be varied and the counter electromotive force of the primary will vary at the same time. Thus the voltage of the circuit can be lowered any desired amount.

The product of the current, read on an ammeter, and the potential, read on a voltmeter, does nor give the average power owing to the difference in phase between these quantities. The reading on a wattmeter is the average power. Thus by taking the ratio between the apparent power (the product of the volts and ampères) and the true power (as read on a wattmeter) the cosine of the log is obtained. This is sometimes called the power factor.

That is, $\cos \alpha = \frac{W}{E\,C}$, where α is the log, E and C the mean E. M. F. and current, and W the true power. Then by the product of the power factor and apparent watts the true watts are obtained. Transformer efficiency varies with the load as in all machines. When the secondary circle is open a certain amount of current still flows through the primary. This is needed to keep the induction through the iron at its normal amount. The hystersis in the core is nearly constant at all loads, and it is the energy thus lost which is supplied by the magnetizing current or leakage. In open circuit transformers this leakage is very large, while in closed circuit ones quite small* (about one amp. for a 5 kw. transformer).

A method of determining the efficiency of a transformer by measuring the losses in it was devised by Dr. Duncan, and is known as the calorimeter method.† It consists in placing the transformer to be tested in a calorimeter and finding the power lost by the rate at which heat is developed. There are many precautions to be taken in the use of this method.

1. Sufficient time must be allowed for every temperature to become steady. 2. All radiation of heat must be prevented. 3. The current must be kept absolutely steady. A test usually takes from two to three hours. The details of the test are as follows:

The calorimeter consists of two metal boxes, one within the other and separated all around by about three inches space. The transformer to be tested is placed in the inside chamber, and water or oil is kept flowing through the space between the chambers at a uniform rate. Thermometers are placed at the entrance and exit of the water or oil and in the transformer. The current is then turned on and the water or oil allowed to flow until the temperatures cease to rise. Then, knowing the amount of water flowing through in one second in grammes, the difference in temperature of the water or oil at entrance and exit, in degrees centigrade, and the mechanical equivalent of heat (4.24), we can calculate the watts liberated. In measuring efficiency, it is only necessary to know the current and E. M. F., in the secondary circuit to add to the product of these and the power factor the losses as measured by the calorimeter, and the result will be the power absorbed by the primary. This method is accurate and commends itself on account of its simplicity and the few instruments used. The time taken for a test is longer than for other methods, but this may be compensated for by the other advantages.

The curves followed by an alternating current or potential can be accurately traced by means of Dr. Duncan's dynamometers and a wiping contact ‡ The way in which it is done is this: On one end of the shaft of the dynamo, furnishing the alternating current, whose variations are to be measured, is fixed a plate carrying a small contact brush, revolving with the shaft. A stationary dial, which can be rotated, is opposite this, and on it is a small wipe-spring, which makes contact with the brush once per revolution. This completes the circuit so that a constant battery current flows through the low resistance coil of of one dynamometer and through the high resistance coil of another. The battery current must be absolutely steady, and to insure this one observer has a "dead-beat" galvanometer across the circuit terminals, while a resistance box in circuit allows the current to be varied. The terminals of the alternating potential, whose curve is to be traced, are connected to the fine coil of the dynamometer, Fig. 4.

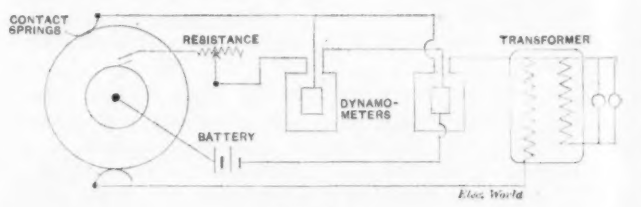


Fig. 4.

through a large non-inductive resistance, while the corresponding current flows through the heavy coil of dynamometer.

It will be seen that at every revolution of the armature a pulse of direct current charges the fields of both dynamos and that a deflection will be obtained which depends for its value on the position of the armature wire at that instant. As these pulses are controlled by the same armature which sends the current under test, they must occur at successive points in the wave of the same phase, as

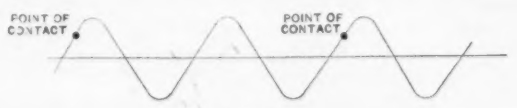


Fig. 5.

shown in Fig. 5. As there are 1,000 pulses per minute steady deflections are produced in the dynamometers, the inertia of the coils preventing vibration. This operation will give one point in the curve, and by rotating the wipe spring the complete curve may be obtained.

To test a transformer by this method, let the primary of the transformer be placed in circuit and the curves will give the power absorbed. The power given out by the secondary can be measured in the usual way. The power will be equal to the average height of each curve multiplied by the cosine of the angle of lag between them.

(To be continued.)

* See "Efficiency of Transformers," by M. v. Dobrowolsky, The Electrical World, May 28 and June 4, 1892.
†See Thompson's "Electromagnet," p. 75.
‡See The Electrical World, Sept. 16, p. 216.

*For some actual curves see The Electrical World, Jan. 14, 1893.
†See The Electrical World, Aug. 6, 1892.
‡ See Kapp, 'Alternating Currents of Electricity."
‖ See The Electrical World, Jan. 14, 1893.

* See The Electrical World, May 9, 1891.
† See "Proceedings Soc. of Teleg and Elec. Eng.," Feb. 6, 1888.
‡See proceedings Am. Inst. Elec. Eng., May, 1892, and The Electrical World, Aug. 6, 1892.

Mr. Martin's Lawsuit—Its Object Cash, Not Vindication—Fruitless Exertion—Why and How It Failed.—IV.

This week's report brings to a close Mr. Martin's side of his case, and a rather curious wind-up he made, as the reader will see when he comes to peruse the proceedings.

After William Hazen, John H. Johnston and J. Frank Dillont had testified for the plaintiff that they were stockholders of the W. J. Johnston Company; had acquired the stock from Mr. W. J. Johnston, the consideration paid being nominal,

CLARENCE E. STUMP was called on behalf of the plaintiff, and being sworn, testified, in answer to Mr. Masten: I am in business in this city. I was connected with the W. J. Johnston Company and a stockholder from the date of the formation of the company until December, 1890. I acquired the stock from Mr. W. J. Johnston. I did not pay him any valuable consideration for it. I disposed of it to Mr. W. J. Johnston in the neighborhood of the 1st of May, 1890. The consideration between me and Mr. Johnston upon the transfer of the stock was $4,000. My salary before the transfer was $2,500; at the time of the transfer the amount was changed to $5,000. I derived an income from the stock, a guaranteed income of $2,500. I had 100 shares of the stock.

Cross-examined by Mr. Keigharn: When Mr. Johnston gave me this stock it consisted of 100 shares. I paid him no money for it. This stock was given to me the same as to Martin, Wetzler and Hunt. Under the agreement which I made at that time I was to get a salary of $2,500 a year; for the first three years Mr. Johnston also guaranteed me $2,500 a year, and if I worked five years I was to own the full 100 shares of stock outright. After I worked about a year and a half, I asked Mr. Johnston to change this arrangement, and I made a new arrangement. The new arrangement was that Mr. Johnston should give me a salary of $5,000 a year, and should buy all my interest in the 100 shares of stock. He purchased outright all my interest in the whole concern. The interest I then had in the stock was the 20 shares that I held and the future prospect of owning the balance. I understood I was to receive the same income as I had previously. *It would take a good while to tell you how it came about that I asked Mr. Johnston to change the amount of my salary and to pay me $4,000 for the stock. I will simply say that I was dissatisfied with the surroundings at the time and desired to dispose of my interest in the business.*

Q. What was the cause of your dissatisfaction? A. *I did not agree with Mr. Johnston in his course concerning Mr. Martin and Mr. Wetzler.*

Q. Did you express any opinion to Mr. Johnston that you thought the business was going to be involved by reason of Mr. Martin's actions? A. Not in that way.

Q. In what way did you express it?

Objected to. Objection overruled.

A. Mr. Johnston and I had a conversation regarding the entanglements that would arise from trouble in the office on account of the well known gentlemen that were about to leave, or had left.

Q. You thought at the time that the paper would suffer from the fact that Mr. Martin and Mr. Wetzler were going to leave? A. I never thought it would suffer to any extent, financially.

Q. What was it you had in mind a few minutes ago when you said you did not express to Mr. Johnston a reason for asking him to carry out that arrangement with you? A. I didn't say I was afraid of Mr. Martin's actions.

Q. I want to know what you had in mind when you answered "not in that way"? You must have something else in mind, Mr. Stump. A. I could not answer it any better than that.

Q. Did you have in mind at that time the efforts that Mr. Martin was making to involve the business in litigation? A. No, sir; I didn't pay any attention to those threats.

Q. Now, about the time that Mr. Johnston made that new agreement with you, did you ask Mr. Johnston to advance you that $4,000 for the purpose of paying off a mortgage on your house? A. *I told him I wanted to use it for that purpose.*

Q. You gave him that as a reason why you wanted him to advance you the $4,000? A. *That was not the reason that I made the sale.*

Q. I ask you if you gave Mr. Johnston that as a reason? A. *Mr. Johnston may have such an impression; I don't remember giving him such a reason.*

Q. Do you remember what time that second agreement was made between you and Mr. Johnston? A. I couldn't give you the date of it.

Q. Is this the agreement? A. That is the agreement.

Q. Do you recall the date when it was made? A. April 5, 1890.

Q. When did you leave Mr. Johnston's employment after that agreement? A. At the end of December, 1890.

Q. That agreement provided that you were to remain in his employ for five years? A. That is what it said.

Q. Did you give him any notice of your intention to leave? A. I gave him two months' notice.

Q. You went contrary to his wishes, didn't you?

Objected to. Objection overruled.

A. Mr. Johnston didn't want me to leave; at the same time I felt that I could not remain. I would like to say that I have no hostile feelings.

This testimony of Mr. Stump's is exceedingly strange.

As an explanation why he got Mr. Johnston to pay him $4,000 for 100 shares of stock, but 20 of which he owned at that time, he volunteers the statement: "I will simply say I was dissatisfied with the surroundings at the time and desired to dispose of my interest in the business."

He does not say that he told Mr. Johnston this.

What he told Mr. Johnston, giving it again in his own words, is, "I told him I wanted it [the $4,000] to use for that purpose," viz., to pay off a mortgage on his house; but he adds,, in a manner which is little short of shameful: "That was not the reason I made the sale."

If Mr. Stump is to be believed, he was at this time so "dissatisfied with the surroundings" on The World that he did not wish to retain any interest in it. He did not, however, tell Mr. Johnston about that, but stated to him something which was not, according to his testimony, the true reason for his wishing to change the stock into money. And as an inducement to Johnston to carry out this exchange he made an agreement to remain for five years, from April 5, 1890—or for five years from just one month after Messrs. Martin and Wetzler were discharged—in the surroundings which were, he says, at that very time, so unsatisfactory to him. This agreement, which required him to remain in the employ of The Electrical World for five years, according to his own testimony, he observed for a few months and then left, against Mr. Johnston's wishes.

We shall make no further comment regarding this.

There was a time when Mr. Johnston firmly believed that Mr. Stump was incapable of being a voluntary actor in such a transaction as he here relates under oath.

Q. Were you in the office of W. J. Johnston, in the Times Building, all the day on Feb. 8, 1890? A. What day was Feb. 8?

Q. It was Saturday? A. I was not there all day.

Q. How much of that day did you spend there? A. Well, I would say positively until three o'clock, with the exception of going out to lunch, of course, and perhaps one or two errands.

Q. Did you receive any telephone calls that day from Mr. Martin? A. That is a hard question to answer. I can't say. If I knew what point you were trying to arrive at.

Q. Will you answer my question? A. I will say that I cannot recollect at the present moment.

Q. Now, I call your attention to the fact that that was the day, I believe, there was a good deal of trouble about the issue of The Electrical World that went out to Kansas City? A. I was not aware that there was any trouble until I heard of it.

Q. You heard afterward that the paper did not go to press? A. I didn't hear anything of the sort.

Q. What did you mean a minute ago by saying that you didn't know of any trouble until you heard of it? A. I know the paper did go to press.

Q. At what time do you know it went to press? A. I don't know what hour.

Q. What day? A. It must have gone to press sometime during Saturday night.

Q. Did you know there was any trouble about its going to press on Saturday afternoon? A. You mean while I was in the office?

Q. Yes? A. I did not.

Q. Did you receive any messages from Mr. Martin during the day which indicated that it would not go to press—telephone messages? A. There was some question regarding—

Q. I ask you now if you will please answer as to whether you received any telephone messages from Mr. Martin during the day which indicated that the paper would not go to press? A. I did not.

Q. Did you receive any urgent messages from Mr. Martin that day as to the whereabouts of Mr. Johnston? A. I don't remember.

Q. Do you remember answering the telephone at all when Mr. Martin spoke on it on that day? A. I think I did.

Q. How often? A. *Only once*, to the best of my knowledge.

Q. At what hour was that? A. It was just a few minutes before I left the office.

Q. At what hour? A. That must have been between—I will change that answer, and I will say it was in the afternoon.

Q. Can't you tell me about what hour that was? A. I cannot.

Q. Was it as late as three o'clock? A. It might have been.

Q. Can you recall what hour you went away from the office that afternoon. A. As near as I can recollect, I went away from the office a very few minutes after three.

Q. Do You know, up to the time you left the office, whether Mr. Johnston was in the office all day? A. Mr. Johnston was not in the office when I left.

Q. How much had he been there all day? A. I don't know, sir.

Q. Do you know whether he was there at all? A. He usually was there on Saturday. I don't know.

Q. Was there any request from Mr. Martin that day for you to issue orders to keep the printing office open? A. *There was not.*

Q. Do you know a man named Colvin? A. Yes.

Q. Was he in the office that day, do you remember? A. Mr. Colvin was in the office that day.

Q. On that 8th of February did you see Mr. Martin at all? A. I can't swear that I did, but I most certainly did. I never knew a Saturday go by when I didn't see him.

Q. Do you recall where you saw him? A. In the office, if at any place.

Q. At what hour? A. I should say it was in the morning.

Q. Didn't you say to Mr. Johnston some time that afternoon that the paper would go to press that Saturday evening? A. I have no such recollection. I may have told Mr. Johnston, and I undoubtedly did, that the advertisements were all ready for the press. I used to look after those.

Q. When did you tell him that, if you can recall? A. I can't say. Those were made up quite early in the day; in fact, we made them up a day beforehand.

Q. You went out to Kansas City the following morning with Mr. Johnston, didn't you? A. I went out in charge of the special train. Mr. Johnston was on that train.

Q. Did you know at that time, when you went out there, that there had been trouble at Atkin's office the evening before about getting the paper to press? A. I had heard of it.

Q. You knew, in fact, that the editorials of the issue that went out there had not been written? A. I had not heard that the editorials had not been written. I had heard that there had been some trouble in getting the paper to press, and it had been put to press in somewhat incomplete form.

Q. Was it the custom of the office, whenever the printers worked on the paper at night, that you always gave orders to have them work? A. Either Mr. Johnston or myself.

Q. Whenever the office had to remain open after the regular closing hour it was always either by your or Mr. Johnston's orders? A. If mine, through Mr. Johnston; we consulted about it.

Q. Were you informed in any way, on that Saturday, the 8th of February, that there was any occasion for you to order the office to remain open? A. *I was not informed of that fact; no, sir.*

Q. You were not asked to have it remain open? A. *To the best of my knowledge I was not; no, sir.*

Q. You were in the office, I understood you to say, until sometime between two and three o'clock? A. I should say I was there until three o'clock, anyhow.

The first agreement was dated Dec. 26, 1888. The amount I received under both agreements was the same amount yearly. The total income was the same under both agreements. The services which I rendered under each agreement were practically the same. Had I fulfilled the first agreement I would have become the absolute owner of the 100 shares of stock. Four thousand dollars was the price Mr. Johnston bought the 100 shares at. That was the understanding between he and I. I felt that the amount was not anywhere near the amount I ought to have received for it. I never considered what the value was and never placed a figure or value on it. The amount which I offered it to Mr. Johnston at in the first instance was $3,000 or $3,500. I don't remember which.

Q. Now, when you got that $4,000 for that 100 shares of stock didn't you regard, at that time, that you were getting its full value?

Objected to. Objection overruled.

A. I will say that I didn't look at it in that light.

Q. Now, answer my question? A. Then, I'll say no.

Q. How much of its value did you suppose you were relinquishing or giving up? A. I didn't suppose anything about it.

Q. How much of its value did you regard that you were relinquishing? A. I didn't regard it.

Q. Did you suppose, or regard, that you were giving up one cent? A. I considered that under favorable conditions it would be worth a great deal more than that amount of money.

Q. Did you regard that it was worth $5,000? A. I believe it was worth $5,000 at that time.

Q. How much over $5,000? A. I don't know.

Q. Now, do you want this Court to believe that when you gave up those 100 shares of stock for the sum of $4,000 you voluntarily relinquished and gave up that amount of money which you regarded as the additional value of the 100 shares of stock? A. Under proper conditions it was worth more than that.

Q. I ask you if you want us to believe that when you parted with that 100 shares of stock for $4,000, you relinquished or gave up anything over and above the amount that was paid to you? A. I don't want you to believe it; no, sir.

Q. If it was worth more money, why didn't you hold on to it? A. I was very glad to get rid of my interest in the concern at that time.

Q. For what reason? A. Two. I have stated before, one was on personal grounds, and the other was that I needed the money.

Q. What do you refer to as "personal grounds"? A. The trouble that we had in the office at that time.

Q. That was trouble between Mr. Johnston and Mr. Martin that you refer to? A. Yes.

Q. Did you consider that trouble on Mr. Martin's part was going to affect the business of The World? A. Not to any extent financially; no, sir.

Q. How long after Mr. Johnston bought that stock from you was it that you resigned? A. About six months, I should say.

Q. What reason did you give Mr. Johnston for resigning?

Objected to. Overruled.

A. I saw that matters were coming to a crisis in the office; I didn't feel that my position was at all assured. Matters were not pleasant; the associations were not pleasant, and I was anxious to get rid of it.

Q. Between the time you sold Mr. Johnston the stock and the time you actually resigned, weren't you making efforts continuously to go into business on your own account? A. Positively not.

Q. Wasn't that the reason you resigned?

Objected to. Objection overruled.

A. No, sir.

Q. Look at that letter; isn't that your resignation? A. It's my resignation, yes.

Q. That states, doesn't it, because you are going into business? A. That does; yes.

New York, Nov. 1, 1890.

W. J. Johnston, Esq., President The W. J. Johnston Company, Limited, 167-177 Times Building, New York:

Dear Sir: After nearly eight years of service to The Electrical World I find myself in a position to enter business on my own account, and I herewith tender my resignation as Business Manager of The Electrical World and Treasurer of The W. J. Johnston Company, Limited, to take effect Dec. 31, 1890.

I shall always look back with feelings of pride and pleasure upon the growth and success of The Electrical World, and I sincerely trust that its future will be even more brilliant than the past.

Very sincerely yours, Clarence E. Stump.

Q. Were you present in the office of The Electrical World on the 5th of March, 1890? A. I was in the office on the 5th of March.

Q. Were you a witness to the trouble which arose there between Mr. Johnston and Mr. Martin? A. I was; a part of it. You will have to refresh my memory there. I can't remember. There was one little incident in connection with the checkbook, I believe. Mr. Johnston took the book away from Mr. Martin. That's all.

Q. Did you hear Mr. Johnston ask Mr. Martin to go to his room? A. I did not, really; no, sir.

Q. Did Mr. Johnston come to your room and ask you to come out and be a witness to the fact that Mr. Martin refused to obey him? A. That, I think, was the day following. I recollect Mr. Johnston coming to my room and asking me to come out and be a witness, but I think it was the day following.

Q. What was it you witnessed on the day following the 5th of March? A. Simply regarding the ejectment of Mr. Martin from the office.

Q. What? A. Something regarding Mr. Martin leaving the office.

Q. Don't you recall that on the 5th of March, the day Mr. Martin was discharged, Mr. Johnston went to your

room and asked you to come out and witness the fact that he refused to go to his office when he ordered him to? A. I remember he asked me to come out and witness something, but I don't recall just what it was.

Q. Do you remember being present at a meeting of the Board of Directors of The W. J. Johnston Company, which was held on Wednesday, the 5th of February, 1890? A. I couldn't swear as to the date. I was present at all except one, I think, that the company held.

Q. Do you recall a meeting of the board of directors at which Mr. Martin discussed, or tried to discuss, the question about his going out to the convention at Kansas City? A. I remember being at a board meeting at which that subject came up.

Q. He was anxious, wasn't he, to go out? A. Not himself particularly; no, sir.

Q. Did he suggest to you at that meeting to vote for a resolution censuring Mr. Johnston for objecting to his going out there? A. If he did, I didn't do it. I don't recollect his putting it in that way; I recollect there was some discussion about censuring Mr. Johnston.

Q. What was it Mr. Martin said to you?

Objected to. Objection overruled.

A. I don't recollect.

Q. Was there any feeling immediately afterward between you and Mr. Martin because you refused to side with Mr. Martin? A. Not that I know of.

Q. Did you ever inform Mr. Johnston that he wouldn't transact business with you and wouldn't speak to you? A. I did; I believe so.

Q. He was angry, wasn't he? A. Who?

Q. Mr. Martin? A. He might have been a little bit so; I don't know.

Q. He declined immediately after that, didn't he to hold any communication with you? A. No, sir; not to the best of my knowledge.

Q. Didn't you inform Mr. Johnston immediately after that that Mr. Martin would not carry on business with you and you couldn't do anything with him? (Objected to. Overruled.) A. Not in regard to that incident; no, sir.

Q. What was the incident that caused that feeling to arise between you and Mr. Martin? A. It would take about half an hour to tell you that, sir, if it was all told. I will say briefly that it was in connection with a certain vote that we took.

Q. What was the vote? A. I don't recollect what it was—whether it was two, four, eight or ten.

Q. What was the vote about? I suppose you refer to a meeting of the board of directors? A. I refer to an action regarding the closing of the stockbook, which I think was the occasion.

Q. Was the meeting you refer to held on the 5th of February? A. I couldn't say.

Q. Wasn't it the same meeting at which the proposal was discussed as to Mr. Martin going out to Kansas City? A. That I don't recollect.

Q. Can you recall, Mr. Stump, the fact that Mr. Martin wanted to go out to Kansas City? A. I know very decidedly that he did not want to go.

Q. In the meeting which was held on the 5th of February, can you recall what Mr. Martin said in reference to his going out to the convention in Kansas City? A. There was a general discussion in the meeting as to who should go out to Kansas City, and Mr. Martin felt that the editorial department should be represented there. I can't recollect what he said regarding himself, but I know he wanted Mr. Wetzler to go. He told me that, owing to his wife's illness, he didn't feel that he ought to go himself, but that he would like to have Mr. Wetzler, his associate, be there. Mr. Johnston, I believe, had arrangements made who should go, and insisted that those people should go. And the consequence was a little—a few words passed between them. That's all.

Q. Mr. Johnston was opposed to Mr. Martin's views in the matter, wasn't he? Didn't Mr. Martin want you to vote for a resolution which he proposed there, and which you refused to vote for? A. I would like to answer that in my own way.

Q. Answer the question, Mr. Stump? A. I'll say no.

Q. You say he did not ask you to vote for the resolution which he proposed, or which he offered?

Objected to. Overruled.

A. I will answer. Mr. Martin had a protest, which he wanted to offer, and which I said I thought was unnecessary, and I requested that he would not do so; and I don't think it was done, if I recollect right. I certainly didn't vote for it.

Q. He omitted to offer it, because you refused to support him, didn't he? (Objected to. Overruled.) A. I don't know.

Q. Was there any feeling between you and him afterward because you refused? A. No, sir; not that I recollect.

Q. Referring to the trouble in the office on the 5th of March, I understood you to say that you witnessed some part of the trouble between Mr. Johnston and Mr. Martin? A. I think I did; yes.

Q. What was it you witnessed? (Objected to. Overruled.) A. The taking of a book.

Q. Did you hear Mr. Martin refuse to go to his room when Mr. Johnston asked him to? A. No, sir; I didn't hear him say that.

How exceedingly odd this is!

Mr. Stump remembers being called to witness something—but forgets what.

"What was it you witnessed?" he was asked, and he answers, "The taking of a book."

This answer is something worse than absurd.

Mr. Johnston testified that he called Mr. Stump out to witness the fact that Mr. Martin would not go to his room. The book had been taken before the order was given him to go to his room. Mr. Stump admits being called *out* of his room—and fails to remember the order—but does remember the taking of the book, which occurred before the order was given, and presumably while he was *in* his room—and not present.

Mr. Martin's side regarded it as somewhat important to him to establish his own version of the book incident. It was clearly not important to him to show the ordering of him to his room and his refusal to go. And the fact that Mr. Stump tries to qualify what he said a few questions above, viz., "I remember he (Mr. Johnston) asked me to come [*out* of my room] and witness something" by saying what just follows "I was standing, I think, right in the entryway to the room," does not help Mr. Stump or his testimony.

His first testmony is in accord with that of Mr. Johnston. His second is not quite so. But the reason for the attempted change is not entirely inexplicable. It is very unlikely that Mr. Johnston would be calling any one to witness this scene if he was not conscious at that moment of being in the right, and of some one else being in the wrong.

In this instance Mr. Stump remembered just enough.

Q. Did Mr. Martin go to his room after you came out of your room? A. After I came out of my room?

Q. Yes, after you came out of your room? A. I wasn't in my room at that time, sir.

Q. Well, where were you? A. I was standing, I think, right in the entryway to the room.

Q. I understood you to testify, a few minutes ago, that Mr. Johnston called you out of the room? A. That was afterward, sir.

Q. *You weren't there* on the 5th of March in the outer office, at the time Mr. Johnston asked him to go to the room? A. I just said that *I didn't recollect hearing him say so.*

Q. When Mr. Johnston asked you to come out to witness the fact that he asked Mr. Martin to go to his room, what day was it that he so asked? A. I couldn't give you the date.

Q. Was it the 5th of March? A. It might have been; *I never kept any record.*

Q. On that occasion when he asked Mr. Martin to go to his room did Mr. Martin comply? *I can't tell.*

Q. Arn't you able to remember, Mr. Stump? A. *I am not able to remember that.*

Q. Do you remember Mr. Martin saying any such thing as this, that he was a partner in the business and Mr. Johnston couldn't order him around? A. No, sir; I didn't hear that.

Q. Do you remember him saying that he would go to his room when he pleased? A. No, sir.

REDIRECT EXAMINATION BY MR. MASTEN:

Q. Do you recollect having seen Mr. Martin on the morning of Saturday, the 8th of February? A. Yes. I think he came into my room in the office of the paper.

Q. Do you recollect his asking you for the mail matter? A. He came in and asked me something about the mail, I know.

Q. Did you give him the mail? A. No, sir.

Q. What did you say in reply to his inquiry? A. I think I told him I hadn't it—"Go to Mr. Colvin."

This testimony does not go together very well with Mr. Martin's theory of his case, viz., that Mr. Colvin was the exclusive custodian of the mails at Mr. Johnston's special command to keep them away from Mr. Martin.

If Mr. Martin at this time believed that, why did he go and ask Mr. Stump at all for the mail; and why did Mr. Stump need to tell him "He hadn't it—go to Mr. Colvin"?

Mr. Martin swore that he knew for months before that Mr. Colvin had the mails by Mr. Johnston's orders—"Johnston took them away from me and gave them to Colvin, although he was a subordinate," is Mr. Martin's testimony under oath.

Q. Do you remember having had any communication with Mr. Martin during that day with regard to a cut which was necessary for the purpose of the paper then going to press? A. I did. By telephone.

Q. Do you recollect what time it was? A. I can't recall the hour; it was in the afternoon, I should say.

Q. And do you remember whether or not the cut that was the subject of this communication was then ready for the paper? A. It was not ready then; no, sir.

Q. What was the substance of your communication about it? A. Mr. Martin asked me for a cut; I told—

Mr. Keigharn (interposing): Can't you identify the cut? A. I can't tell you. I know it related to something in the East. I think the copy came from Boston. I couldn't tell you the name; I think it was something regarding a street railway. But I told him it was not ready, and it would be impossible to give it to him until later.

Q. Do you remember whether Mr. Martin said anything about the size? A. He asked me if I couldn't give him the size, and I sent down and got the size.

Q. At this meeting, at which there was a discussion with regard to the representation of the paper in Kansas City, what was said, if you recollect, by Mr. Martin with regard to the reason why it was desirable to have representation there of the editorial staff? A. I don't recollect the exact words of the conversation, but he may have said it was customary to have the editorial staff there, and he would like to have some one from his department direct.

Q. Did Mr. Martin express any wish that he himself or that Mr. Wetzler should go to that convention for their own convenience, accommodation or pleasure? A. My recollection is that he said that he would like to have Mr. Wetzler go.

Q. Did he state any reason why he would like to have Mr. Wetzler go? A. He said something, it would be remarked if the editorial department was not represented there. That is as near as I can recollect it.

This solicitude on Mr. Martin's part for the interests of The Electrical World, as shown in this apology for him, is really very charming. It means that Mr. Martin understood the interests of the paper and Mr. Johnston did not; and so much so that Mr. M. wanted to have Mr. J. censured by the Board of Directors for not understanding them as he did. But this solicitude was not prevailing in Mr. Martin's mind in the printing office at five on the evening of Feb. 8, when the question was, not the representation of the paper at the convention, but the paper *itself.*

Q. Do recollect anything being said about the question of the payment of the expenses of some representative of the editorial staff, by yourself or anybody else? A. Mr. Martin said something when he found that no one was going, that if it was a question of money, he would rather go himself, if he could afford it, rather than not have anybody there; but he couldn't afford it. I told him I would chip in and help make up a purse to let him go, if he wanted to go very bad.

Q. With regard to the letter shown you, which is your letter of resignation, what explanation, if any, do you wish to make with regard to the statements therein contained as to your entering business on your own account? A. The explanation I desire to make is simply an answer to the question, had I been negotiating for another position. You made it out that I said that I had not, when in reality I had. I had not at that time. You asked me if I had prior to that time and the date of that resignation. The propositions for me to make a change in my office had come voluntarily from two sources, without any of my solicitation, and matters had reached a crisis at that time that I didn't feel comfortable, and I didn't feel that I could do much good work in my position, and would not be of much value to the paper if I staid there.

This "explanation" of Mr. Stump is very lame.

Although he was under contract to remain five years with the W. J. Johnston Company, on the making of which agreement he induced Mr. Johnston to pay him $4,000 in cash for 100 shares of stock, 80 of which he did not own, when "propositions for him to make a change in his office had come voluntarily from two sources, without any of his solicitation," he promptly made a change and broke his contract, because "matters had reached a crisis at that time that he didn't feel comfortable and he didn't feel that he could do much good work in his position, and would not be of much value to the paper if he staid there."

What he told the lawyer before as having made him feel uncomfortable was the controversy between Mr. Martin and Mr. Johnston. He did not leave The Electrical World, however, until the 31st of December, 1890, whereas Mr. Martin had been discharged on the 5th of March, and was out of there nearly nine months before. Mr. Stump, we have no doubt, felt more comfortable in leaving with the price of his 80 shares in his pocket than he would without it, and he arranged matters so that he got it.

Q. What was your position in the W. J. Johnston Co., Limited? A. I was treasurer.

Q. According to the custom of the paper, who was in the habit of giving the orders for overtime work at the printing office? A. The orders were usually given by me for Mr. Johnston or sent by him by messenger, or by myself.

Q. Was it either *the duty* or the custom of the editorial staff to give such orders? A. It was not *the custom* of the editorial department.

Q. Was there any extra charge made by the printers for doing overtime work? A. There was.

Q. Have you any feeling of hostility toward Mr. Johnston, Mr. Stump? A. I never had any.

RE-CROSS EXAMINATION BY MR. KEIGHARN.

Q. I understand you to say that on Saturday morning, Feb. 8, there was about one form open. A. I think that would be about right.

Q. It was all arranged, wasn't it? A. Practically all made up.

Q. The fact that it was open, if such was the fact, would not have delayed the paper going to press at noon time on Saturday, would it? A. The fact that it was open?

Q. Yes, if it were a fact that it was open? A. You mean if the rest of the paper had been ready?

Q. Yes? A. No, sir; it would not have delayed much.

So this last dodge, that an open form delayed the paper, fails.

What Mr. Stump says just following about the cut agrees substantially with what Mr. Weithas said—that the absence of the cut could not have caused any delay. Weithas said the cut was received at about three o'clock, and that he had then a space reserved, ready to place it in.

It is really strange, if Mr. Martin had any faith in what he positively swore to, that the delay was caused by Mr. Johnston, and through his fault alone, that he should be continually trying to bolster up his case by such subsidiary efforts as his attempts to show: "Mails delayed," "printers not ordered to work overtime," "cut delayed," etc., etc.

Q. At what hour was it that you saw Mr. Martin on the morning of Saturday, Feb. 8, when you sent him to Mr. Colvin for the mail? A. I think it was in the neighborhood of 10 o'clock.

Q. You didn't see him afterward that day? A. To the best of my knowledge I did not.

Q. Mr. Masten asked you about an engraving, or cut, which you didn't give the name of; are you able to recall it now? A. I can't recall the name of it, except to say that it related, I think, to the West End road in Boston.

Q. Do you know it to be a fact? A. I cannot swear to it.

Q. How do you know it was not delivered to Mr. Martin until some time in the afternoon? A. Because I sent down to the engravers.

Q. Who were the engravers? A. I think it was Bartholomew & Peckham; they have dissolved business.

Q. If the paper had been otherwise ready to go to press, would the absence of that cut up to early in the afternoon have in any way caused any delay? A. If the paper was ready, would the absence of that cut cause any delay?

Q. Yes. A. The fact that it was not there would cause delay.

Q. After it arrived there, how long would it delay the paper going to press if it had been otherwise ready?

A. I should say that they could lock the form up after an hour.

Q. How early did you say that that engraving got into Mr. Martin's hands? A. I didn't say that; I didn't say what time it got into his hands.

Q. What time? A. I testified before, that Saturday afternoon I went away shortly after giving him the size of the cut; and consequently I wasn't there when he received it.

Q. What was your object in furnishing him the size? A. So that he could leave a space for it in the paper.

Q. So that when the engraving arrived it was merely a matter of putting it in its position? A. Putting it in and locking it in.

Q. In reference to your explanation of your resignation from Mr. Johnston's employment, you said you had business propositions from two sources? A. Yes.

Q. Have you any objection, Mr. Stump, to saying what the sources were? A. No, sir; and I will further say that if I hadn't received them I would have gone away anyway. One was from the gentleman with whom I am now associated, and the other was from Mr. Worthington, of the "Electrical Review." I would just like to make one statement in view of what might seem to be rather queer answers to some of these questions—that is, the fact that Mr. Martin and several of us at that time were not on speaking terms, and I, therefore, was a very unwilling witness of what took place in the office, and made myself so purposely.

As is seen from Mr. Stump's story, he had an agreement with Mr. Johnston to work for five years from Dec. 26, 1888, for a salary of $2,500 and 20 shares of the stock of the company for each year he worked. He worked one year under this agreement, and was given the 20 shares for that year. In April of the second year he asked Mr. Johnston to at once advance him the full value of the entire 100 shares; which shares, or the value thereof, he was not then entitled to, and would not be entitled to until he had worked for five full years, or three years and eight months after the time at which he asked to be paid the value of the 100 shares. This was a payment made as an advancement to Mr. Stump at his own request and for his own accommodation. Mr. Johnston made it because he trusted to Mr. Stump's honor, and because he asked it as a favor, being in need of money, which he told Mr. Johnston he wanted to use for the purpose of paying off a mortgage on his house. This was all he claims to have told Mr. Johnston, and this told to him or any other man would naturally lead him to believe that that was the reason why Mr. Stump wanted to secure cash for his 100 shares. But while Mr. Johnston was being lulled to sleep under this delusion, what was going on in Mr. Stump's mind? What he told Mr. Johnston was never the reason in his mind "why he made the sale," and when he made the second contract, which required him to remain in his position for five years, all the regard that he had for that contract was that it merely "said" so and so. There was evidenly no intention in Mr. Stump's mind that what it said should even come to pass. When he was asked if that contract did not require him to remain for five years, he answered flippantly, but yet with a seeming reservation which indicated a reluctance to admit under oath that it ever had such a meaning in his mind, "That is what it said." When there arose what he thought was a favorable opportunity for him to leave he went, although under contract to remain, after having been negotiating for some time with "two gentlemen." "One of the gentlemen I am now with," says Mr. Stump, and he adds, no doubt in an effort to somewhat extricate himself out of his awkward situation, "they approached me to make a change in my office without any solicitation from me." What a pity that these worthy gentlemen did seduce the unsophisticated Mr. Stump. And then, as a last shuffle, to try to reconcile all his inconsistent actions, he says that even if these gentlemen had not approached him, "he would have gone away anyhow." This last we believe to be strictly the truth. Having secured the value of 100 shares, a part of which he admits he did not earn, we do not know of anything which would have kept him. A contract certainly would not, and did not, because all the binding force that such a document had with him, so far as requiring him to fulfill it, was merely to create in his mind such an impression as: "That's what it said," but not that that was what he meant, or intended when he signed it.

Arc Lamp Litigation.

The United States Circuit Court of Appeals of the Seventh Circuit on Oct 2 reversed the finding of Judge Gresham in the court below, in the case of the Western Electric Company against the Sperry Electric Company relating to one of the Scribner arc lamp patents.

The claim directly at issue is as follows:

In an electric arc lamp, the combination, with an elec tromagnet in the shunt of the arc and its armature, of an electromagnet in the main circuit and its armature, said electromagnet in the main circuit being carried upon a movable support, said support being controlled by the armature of the electromagnet in the shunt of the arc, whereby the position of the main circuit electromagnet and its armature is caused to vary in response to the variations in the strength of the current passing through the electromagnet in the shunt of the arc.

The application for the Scribner patent was pending in the Patent Office for more than seven years, and Judge Gresham, in the court below, held that the application had been abandoned in the Patent Office, which finding, however, the Circuit Court of Appeals has just reversed. Judge Woods, who delivered the opinion, said that there is a material difference between the abandonment of an invention and the abandonment of an application for letters patent thereon by failure to comply with Section 4,894 of the Revised Statutes. The first gives the invention to the public, and once done the act is irretrievable; but, besides the power conferred upon the Commi-sioner of Patents to relieve an applicant from an abandonment of his application under the statute, an application, which has lapsed or been rejected or withdrawn, may be renewed or repeated so long as the invention itself has not been abandoned by reason of a two years public use or otherwise.

The Court said that in the present case there was no abandonment of either the invention or application for the patent, and that the Patent Office decided there was no such delay in the prosecution of the claim as to work a forfeiture of the application.

An interesting point in the decision is the bearing of an invention considered as a device and in regard to its functions, which has a direct relation to the trolley cases now in court. The judge said:

The magnetic current itself is not a part of the device any more than is water an element of a water wheel. In one case water is the power and in the other the electric current, and the devices are contrived for the purpose of controlling and applying the power. The invention is in the device, which may have one, two or more functions, one of great and another of trifling worth. It may be supposed to have a function which it has not. The patent is upon the device, and not upon the functions, real or supposed, and if the device is appropriated in its essential features, it will be an infringement, notwithstanding some change in the location and relation of parts, whereby a doubtful function of little comparative worth is eliminated. At first Scribner, it is clear, believed the up-and down compensating movement of the armature in the main circuit, irrespective of the action of the regulating magnet, to be an important feature of his lamp; but before the patent issued, without changing the drawing or modifying the structure of his device in the le st, he presented an amended specification in which he repudiated that idea, and described the armature in operation as assuming and holding a definite relation to the magnet. So long as he did not change the structure of his device or invention, he had the right to change the specification, even though he did it with reference to the Sperry patent, which was applied for and issued while his application was on file, and, the specification being as we find it, there is no support for the proposition that for the purpose of preserving the possibility of a function, which the patentee had repudiated before the patent issued, the claims, though worded differently, should be so read as to cover only the exact construction and relation of parts illustrated in the drawing. The proposition is not reasonable, nor, so far as we know, supported by authority.

The first claim of the Sperry patent, and other claims not quoted, were declared to be essentially the same as the first and second claims of the patent in suit, and the lamp made by the respondents was decided to differ in essential elements from the complainant's lamp only in respect to the relative positions of the main-circuit magnet and its armature, horizontal parts being made vertical, and *vice versa*.

The judge concluded that the patent in suit is valid, that it belongs to the complainant as assignee of the patentee and that the respondents before suit had infringed the first and second claims thereof as charged.

The Fusing Point of Copper Wires.

BY J. C. LINCOLN.

The accompanying cut shows a curve giving the relation between the fusing points and diameters of copper wire. The ordinates represent diameters in one-thousandth of an inch, and the abscissae the corresponding fusing currents.

The readings were taken under the following conditions: The brass terminals in which the fuse was fastened were five inches apart between their nearest points, and weighed two ounces each; their shape was such that the wire was raised from three-fourths to one inch above the slate base. The room in which the experiments were made was guarded from draughts and had a temperature of about 80 degrees F. A Weston direct-reading ammeter was used in series with a rheostat and the fuse.

The points determined are plotted and the full curve drawn through their mean positions. A large number of readings was taken, giving a reliable character to the curve which, as will be seen, is a very fair one.

The curve was found to have approximately the equation, $x = .14\ y^{1.7} + 2.3$; the dotted curve is drawn to correspond exactly with this equation.

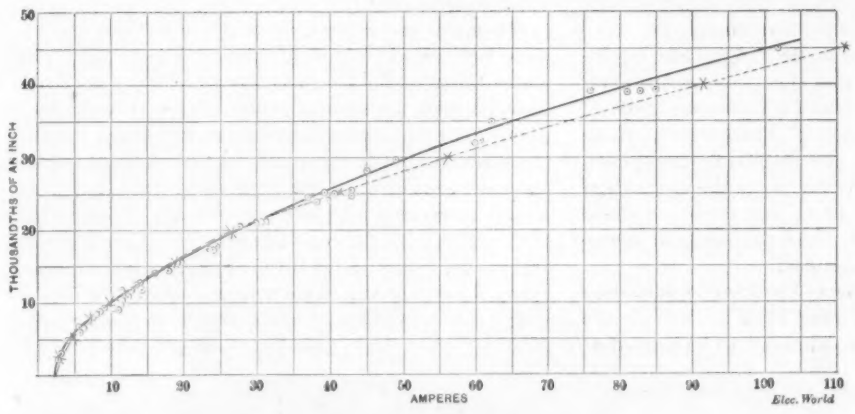
The Comparison of Specific Inductive Capacities.

BY FREDERICK T. IDDINGS.

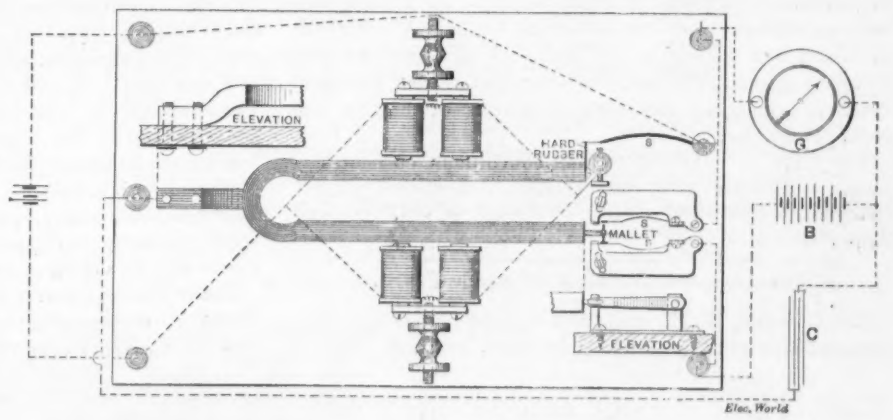
To those interested in the determination of comparative specific inductive capacities, one of the greatest drawbacks to experiment in this direction is the necessity for the employment of great condenser surface in order to obtain, by the usual direct deflection method, readings sufficiently great to be reliable. The writer, having had occasion to compare the specific capacities of a number of insulating substances, and having been met on the threshold of his investigations by the obstacles referred to, devised a simple method, by the use of which it was possible to obtain very satisfactory results, even when exceedingly small surfaces were used. The apparatus required is an electrically vibrated tuning fork, of about 280 double vibrations per second, one limb of which is provided with a platinized extension vibrating between two light platinized springs, which are limited and damped so that their individual periodicities may not conflict with that of the fork. These springs are adjusted relative to the fork extension, so that when in vibration it shall make contact with them alternately, but shall be out of contact with both springs at the position of rest. The tuning fork is well insulated and provided with a binding post for the attachment of the lead. One spring is connected with the pole of the battery, the other spring to one terminal of galvanometer, and the fork to one terminal of condenser, the other terminals of the battery, galvanometer and condenser being connected together. The action when the fork is in vibration is that at one limit of swing the condenser is charged by contact with the battery spring, and at the opposite limit the charge is neutralized through the galvanometer by contact with the other spring. The succession of impulses being so rapid (280 per second), the effect upon the galvanometer is nearly that of a continuous current, and the deflection consequently steady. Where the swing of the needle is caused by one impulse lasting only a fractional part of the time occupied by the needle on reaching the maximum, the motion is due chiefly to momentum. It will be readily perceived that when the first impulse is followed by 280 others of equal energy, almost the maximum movement is produced.

The rate of vibration of 280 was adopted because it nearly approached the rate of the vibrational induced currents on telephone lines, due to electric light circuits; any other rate might be adopted, but the higher the more difficult of adjustment and the lower the further removed from continuity are the discharges.

It is possible with this arrangement to measure the static capacity of a person insulated from the floor, and to note the increase of capacity due to the approach of other (uninsulated) persons to him, when using a Thomson reflecting galvanometer and fifty cells of battery.



CURVE SHOWING FUSING POINTS OF WIRE.



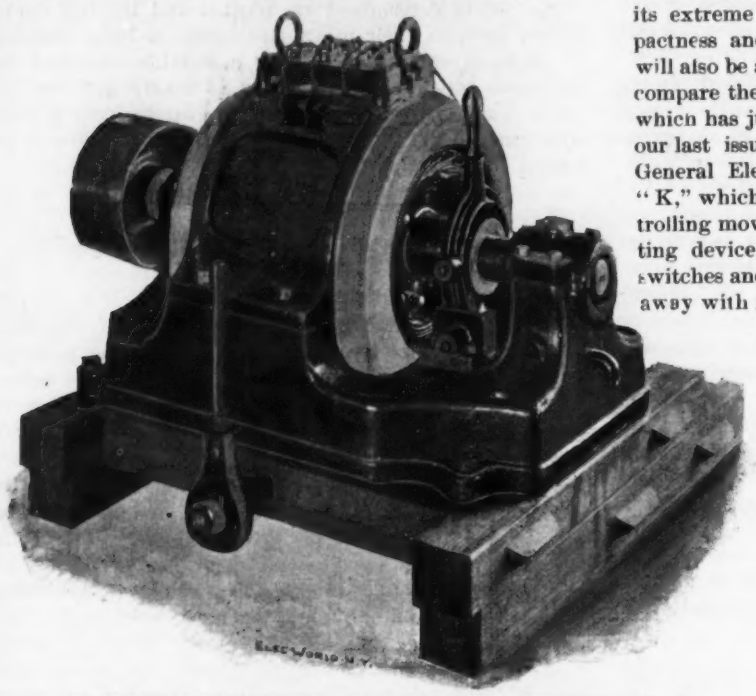
COMPARISON OF SPECIFIC INDUCTIVE CAPACITY.

NEW BOOK.

THE DYNAMO: ITS THEORY, DESIGN AND MANUFACTURE. By C. C. Hawkins A. I. E. E., and F. Wallis, A. I. E. E. London and New York: Whittaker & Co., 1893. 520 pages; 190 illustrations. Price, $3.

In their preface the authors state that it has been their endeavor to furnish a simple yet accurate account of the theory and design of the modern dynamo. Claim for originality is made only for certain definite points, such as the construction of the equations for magnetic leakage, the heating of dynamos and the E. M. F. of alternators, and for a certain novelty in the method of treatment by which facts are represented.

Of the 21 chapters in the book the first 12 are devoted to a consideration of the general principles involved in dynamo design and to descriptions of different types, two chapters being on alternators. One chapter is next given to armatures, three to the field, and one each to



MULTIPHASE MOTOR IN USE AT CONCORD, N. H.

sparking and the angle of lead, the heating of dynamos, descriptions of typical dynamos, dynamo designing, and on the working and designing of dynamos.

While we fear that the book will be of little value to practical designers, except, perhaps, as a reference work at times, to the student is will be useful in stating in detail the theory of the dynamo in a simple and correct manner. The non-mathematical reader will particularly appreciate the work on account of the few formulas employed.

The book is confined to the continuous current dynamo, with the exception of some descriptive matter relating to alternators, and the motor is only touched upon incidentally.

The Concord, N. H., Multiphase Plant.

The Concord, N. H., multiphase plant installed by the General Electric Company, at Sewall's Falls, N. H., was recently put in operation with great success. There are now in place four pairs of turbines of a capacity of 400 h. p. to each pair, a total of 1,600 h. p., and eventually there will be five pairs, making in all 2,000 h. p. to be used for generating electricity. It is the intention of the company to ultimately install six 250 kw. generators, each of which will be about 12 feet long and eight feet high, and weigh about 15 tons. The frequency used is 50 periods per second, or 6,000 alternations per minute. The voltage on the street lines is 1,100, which is transformed to 110 in the secondary circuits.

We illustrate one of the three-phase motors in use which was designed under the direction of Dr. Louis Bell; it is rated at five h. p., is about 18 inches high, and requires a floor space of four square feet. The plant was installed under the supervision of Mr. Eugene F. Carpenter.

The General Electric Company at the Street Railway Convention.

The General Electric Company will make a very fine and practical exhibit of street railway motors and supplies at the Milwaukee Street Railway Convention. Its principal exhibit will, however, consist of a working demonstration of the qualities of its new railway motor known as the G. E. 800, which was illustrated and described in THE ELECTRICAL WORLD of June 3, 1893. Street railway managers will have an opportunity of verifying its claims, which are its extreme lightness, ease of control, accessibility, compactness and the noiseless way in which it works. They will also be able to witness its lightness upon the track and compare the advantages of the new method of suspension which has just been introduced and which we described in our last issue. With this motor will be shown the new General Electric series parallel controller known as type "K," which comprises within itself all the necessary controlling movements. The case contains, with the regulating device, the connection board, the motor cut-out switches and the reversing switches. Its introduction does away with moving parts beneath the car, and being provided with a magnetic blow-out, arcing is prevented. By means of an interlocking device between the reversing switch and controller the operation of either, unless in proper position relative to the other, is impossible.

In addition, a special and effective display will be made of a complete new line of overhead line apparatus, which will be introduced for the first time at this convention. In devising the different appliances, especial care has been expended in meeting all the requirements of the most arduous railway service. The insulating compound used is known as the "L" compound. Its insulating qualities are claimed to be higher than has been heretofore obtained, and its peculiar composition and the pressure to which it is subjected render it most suitable for the purpose for which it is employed.

The General Electric Company will have two cars in service on the Milwaukee lines. One, a Brill car and truck fully equipped with two G. E. 800 motors and type 'K" controllers; the other a Brill double-decked car also equipped with two G. E. 800 motors and type "K" controllers. The double-decked car will be found a handsome piece of car building and electrical equipment. Furthermore, there will be one McGuire truck and one Peckham truck, each equipped with motors and controllers, as in the case of the Brill cars, and one Lewis & Fowler car on a Peckham truck similarly equipped. The three last-named equipments will be shown in the exhibit hall.

Passes will be given at the General Electric Headquarters at the Convention to all street railway men to ride on the two cars in service. The headquarters will be located at the Pfister Hotel, on the second floor, where elegant parlors have been secured, and where all railroad men will be made welcome. The interests of the General Electric Company at the Convention will be under the care of Mr. Theo. P. Bailey, of the Chicago office, assisted by Mr. G. K. Wheeler, Mr. G. Atterbury, and others from the same office. Mr. O. T. Crosby, Mr. Theodore Stebbins, and Mr. R. H. Beach, will be present from the head office in New York. Mr. W. J. Clark from the Cincinnati office, and Dr. T. Addison from the San Francisco office. The engineering representatives will be Mr. W. H. Knight, Mr. J. B. Blood, and Mr. A. K. Baylor.

The Chloride Storage Battery.

It is only comparatively recently that other forms of storage batteries than the usual Plante or Faure type have come to the front, and one of the most interesting of these is that known as the chloride battery, though it should be understood that the chlorine salts from which the name is derived only enter during the preliminary stage, all traces of chlorine being eliminated before the forming process. The essential feature of the battery consists in the production of spongy lead masses or plugs, in a strong supporting plate of a lead and antimony alloy; this is done by casting tablets of chloride of lead and zinc into a plate and afterward reducing the same, so that the lead alone remains in a pure metallic spongy form.

The material for the tablets is prepared by melting together in a certain definite proportion powdered chloride of lead and chloride of zinc. The fused chlorides are next cast into tablets in the form of beveled plugs, which are then placed into a framing mold and antimonious lead cast around them. That the framing metal may be in as dense a form as possible so that it will not—like the material destined to become active—be attacked by the oxidizing current, the molten alloy is forced around the tablets under heavy pressure, which not only forms a dense metallic frame, but also secures a very perfect contact between it and the tablets. Owing to the double bevel of the plug it cannot fall out, and also avoids the fault of the ordinary plug of the hour glass form of splitting in the centre and the halves falling out on either side.

When the completed plate is taken from the mold it is placed in a bath of chloride of zinc in connection with a slab of metallic zinc which forms a primary battery—the zinc acting as a positive element, while the molded plate constitutes the negative element. The resulting electrochemical action causes the withdrawal of the chloride of zinc from the tablets by simple solution in the bath, and the combination of the chlorine of the chloride of lead

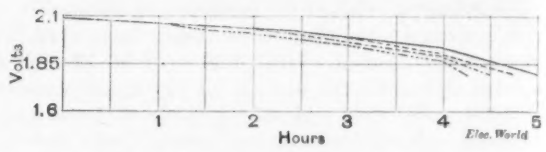
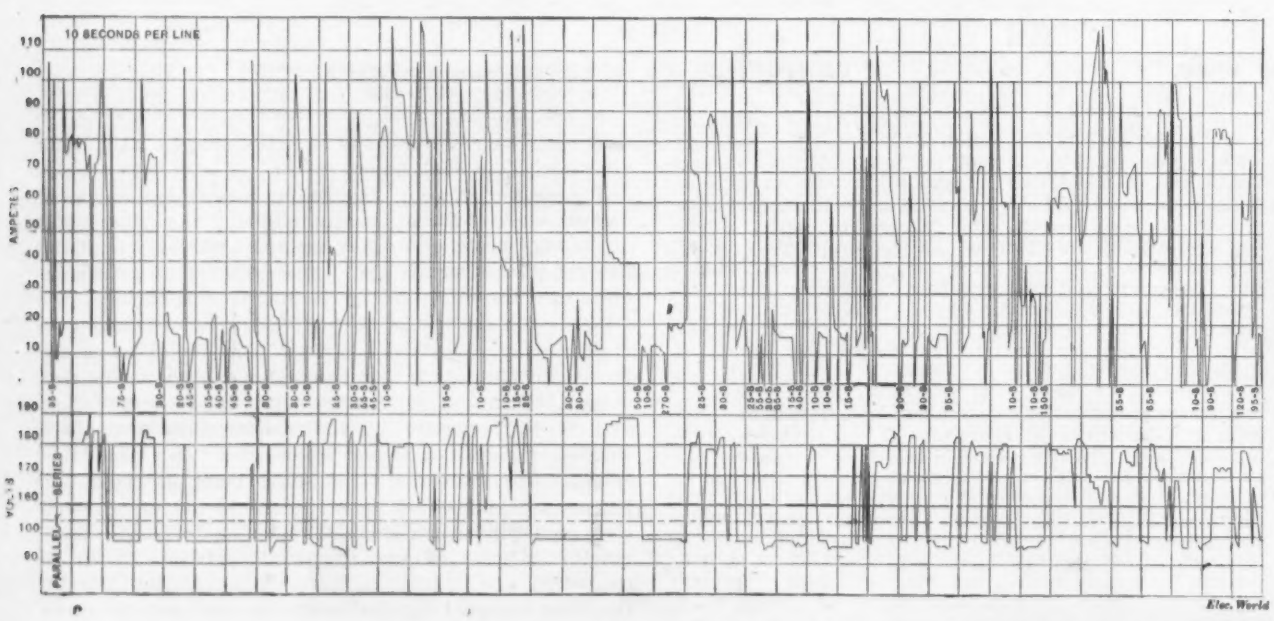


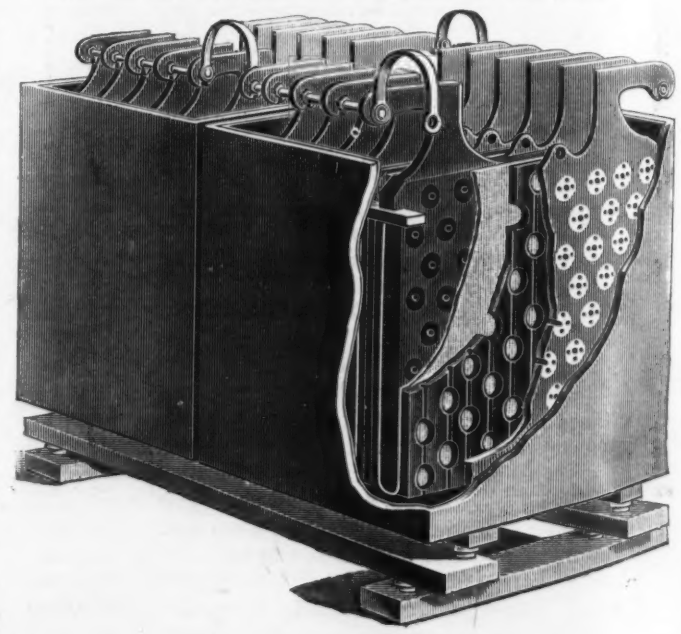
FIG. 2.—CHLORIDE STORAGE BATTERY.

with the zinc, forming chloride of zinc. It is thus seen that the chloride of lead in the tablets constitutes the material which becomes active by electrical disintegration through being connected with the zinc plates in the bath of chloride of zinc.

When this reduction is complete, a number of plates is set up as positives in a bath of dilute sulphuric acid, plain lead plates being used as negatives, and a heavy current passed through them for several hours. When the plates are removed from this bath they are next charged continuously in connection with the plain lead permanent negatives for several weeks or until the crystalline lead has been completely converted into peroxide of lead. Positive plates are then set up with the requisite number of negative plates to form cells, which, after being charged a few times, are then ready for shipment. Two cells are shown in Fig. 3.

The function of the chloride of zinc in this process is twofold. In the first place it is impossible to cast plates of chloride of lead without it, as the casting on cooling falls to pieces, so that the admixture of chloride of zinc is absolutely necessary on this account. In the next place, by the use of chloride of zinc it is possible to so control the density of the plate as to produce any desired porosity, and, as within certain limits the capacity of a plate is proportional to the porosity, this use of chloride of zinc is of vast importance. The curves of Fig. 2 show how the capacity of four cells of equal size and weight varied with different percentages of chloride of zinc. In the manufacture of the ordinary red lead or pasted plate, the density of the material depends upon the pressure used in entering the red lead





FIGS. 1 AND 3.—CHLORIDE STORAGE BATTERY.

into the grid. and consequently the plates are seldom if ever uniform. In the chloride cell, on the other hand, the tablets are absolutely uniform. The mixed chlorides on cooling crystallize into a hard stony substance, and after reduction the metallic lead is left in the form of the needle-shaped crystals running through the plate perpendicularly to the surface; the elimination of the chlorine and zinc provides minute cell spaces around these crystals so that an immense surface is offered for the absorption of oxygen in the forming process.

The capacity of cells of this type is from five to six ampere hours per pound of plate, and the discharge rate corresponding to this is one-half an ampere for each pound of plate, a higher rate than recommended for any other lead element. At this rate the watt hour efficiency is from 75 to 85 per cent.

Special care is given to the insulation of the plates, it being well known that short circuiting is one of the main causes of trouble in storage batteries. To overcome this, the positive plate is enveloped in woven asbestos cloth, and between the positive and negative plates is a perforated grooved board of insulating material with perforations which are opposite the pieces of active material in both plates, leaving a free circulation of the electrolyte between the plates and at the same time keeping the asbestos cloth pressed against the face of the positive one, thus holding the peroxide always in position.

One of the great advantages of this type of battery is its applicability to cases where there is a large variation in load and consequently in discharge. Fig. 2 shows the discharge obtained from a battery of 96 cells on the road of the Metropolitan Company, Washington, D. C., from which it is evident that the great variations would soon be destructive to the older types of batteries.

This battery has been used for nearly two years by the North Paris (France) Tramway Company, which operates several roads with battery cars, using about 40 in all. The Paris factory has for some years turned out over five tons plate a day, and the Paris Popp central station equipped by it some three years ago has had the accumulators in constant use ever since. There are 24 battery sub-stations, and in the neighborhood of 100,000 lamps are run daily from these batteries. The plates in some of the cells weigh 100 pounds each, a complete cell weighing over a ton, and discharging at the rate of from 1,000 to 2,000 amperes each.

The Chloride storage battery is manufactured in America by the Electric Storage Battery Company, Drexel Building, Philadelphia.

The Kennelly Patent Standard Electrostatic Voltmeter.

This instrument is intended for use in central stations, and to be secured permanently in an upright position against wall or switchboard. It can be used on either continuous or alternating current circuits, and is made in two sizes indicating up to 600 and 1,150 volts respectively.

The instrument, represented in the accompanying figure, and manufactured by the Edison Manufacturing Company, 110 East Twenty-third street, New York, is very simple in design, and, acting entirely on electrostatic principles, takes no current. A horizontal aluminium vane is suspended bifilarly, and carries vertical sectors of the same metal, which travel freely in curved brass grooves.

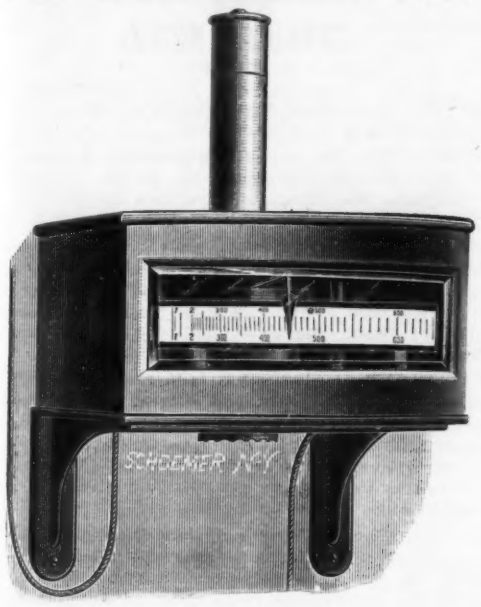
The vane and sectors are electrically connected through the suspension wires with one side of the circuit, and the brass grooves with the other, so that the electromotive force sets up an electrostatic attraction between these parts, and the sectors enter the grooves, twisting the suspension wires until arrested by gravitational force. The vane and sectors carry a horizontal pointer of six inches radius over the curved face of a scale eight inches long, and the index points to the E. M. F. supplied to the instrument terminals. On the scale of the 600-volt instrument intended for use on 500-volt circuits, a variation of five volts, or one per cent, at load makes a change of about one-eighth of an inch.

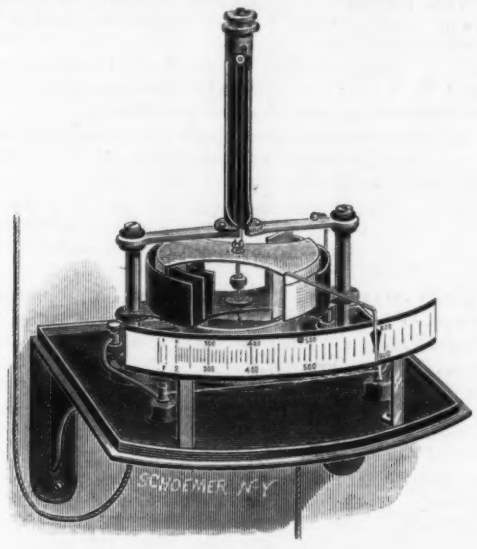
As the vane and grooves are connected directly across the bus bars, any accidental metallic contact between them would produce a short circuit. To prevent this, the walls of the grooves are heavily japanned so that contact with the vane allows no spark to pass. As an additional security a fuse of fine wire is added within the case.

The vane suspension terminates beneath in a light metallic damper immersed in non-evaporating oil, so that the movements of the pointer are practically deadbeat.

As the instrument simply measures electrostatic force against gravity, there is nothing within its action liable to change with time, and there are no pivots to introduce friction. The advantage of a bifilar suspension is its independence of torsion and such errors as temperature or elastic fatigue in wires is capable of producing.

The base and frame of the instrument are of cast iron, the cover of polished wood, and the front of beveled glass. The instrument is a handsome ornament to a switchboard. Its height above base is 11 inches, breadth 14½ inches, and projection from the wall 13 inches. It is unaffected by magnetic fields or temperature, or moderate vibration or belt electrification. It has undergone satisfactory trials during the past eighteen months.





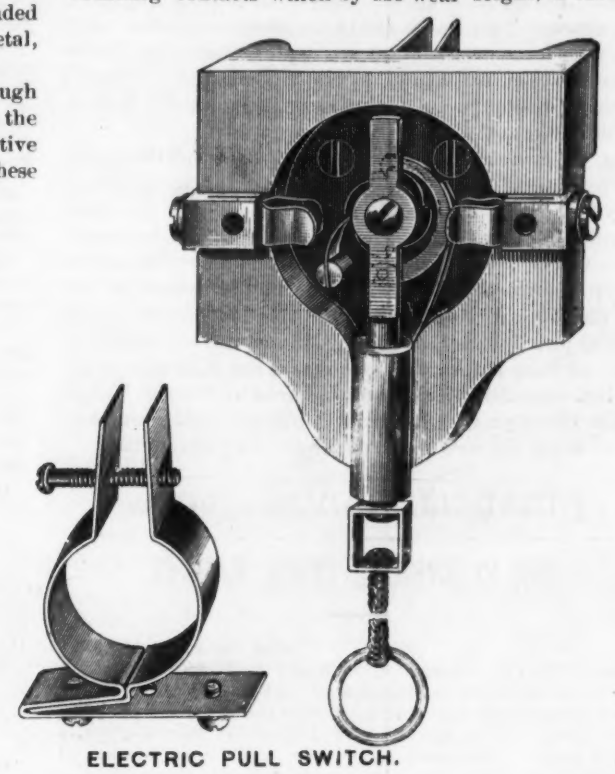
A STANDARD ELECTROSTATIC VOLTMETER.

An Electric Pull Switch.

A neat pull switch has been recently placed on the market by the Universal Electric Pull Socket and Switch Company, 27 Beaver street, New York, which will prove very convenient for attachment to electroliers, or used as a wal switch will save the expense and disfigurement of running leads for switches located so as to be directly reached.

As may be seen from the illustration (which is exact size), the circuit in the switch is broken and made instantaneously by simply pulling the chain or cord. It has brushing contacts which by use wear bright, is easily adjusted to any electrolier, and by its adjustable extension clamp can be used on ¼ to 1¼-inch piping. As an electrolier switch it is out of sight, being covered by the canopy or placed within a covering ball; for use on walls the clamp is removed and it is fastened by screws through the two holes in the porcelain base.

The advantage of this switch is the resultant saving in wiring and labor in putting up, its durability, and above all the great convenience in lighting and extinguishing, thereby also effecting a saving in current and life of lamps.



ELECTRIC PULL SWITCH.

An Improved Extension Truck.

Besides the great direct benefit conferred by electricity in its numerous applications, amounting to a revolution, it has had also a notable effect in bringing about improvements in older branches with which it has come into contact. This applies especially to the construction of street cars, and particularly to their mounting, which is attaining a perfection little thought of even a few years ago. The Peckham Motor Truck and Wheel Company, Kingston, N. Y., has taken no small part in this movement, and is not even yet inclined to rest on its laurels, as recent improvements made by it testify.

The latest Peckham truck is an improvement in their 6-A type and consists in giving it a still further extended spring base, which, with the addition of one more spiral spring at each end, gives increased support to the car body and thus still further assists in doing away with any tendency toward "teetering."

As applied to their 6-A standard truck, about two feet is added in length, making the solid forged top frame 16

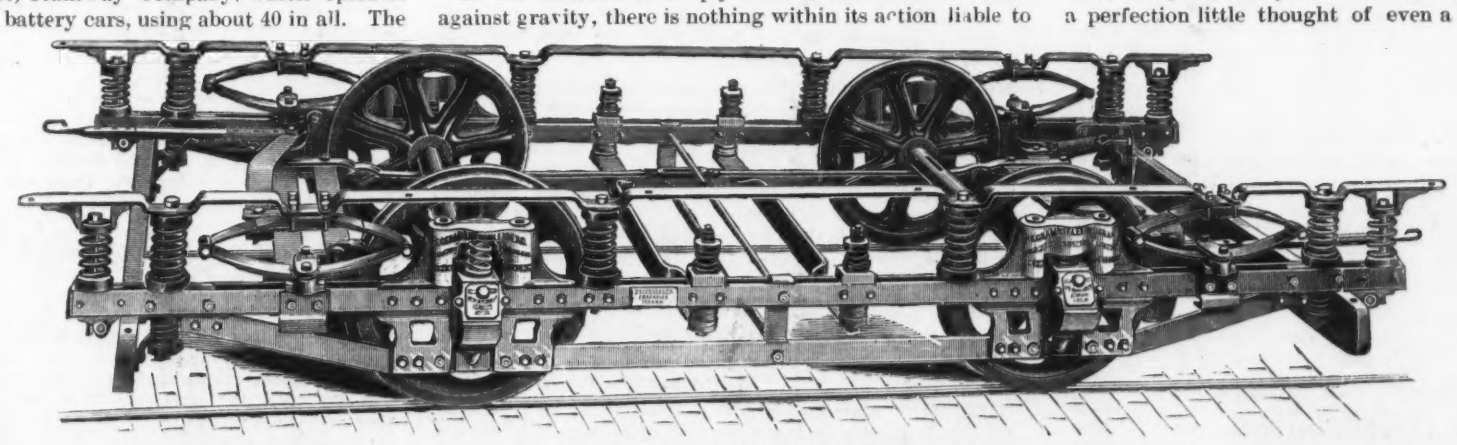


FIG. 1.—IMPROVED EXTENSION TRUCK.

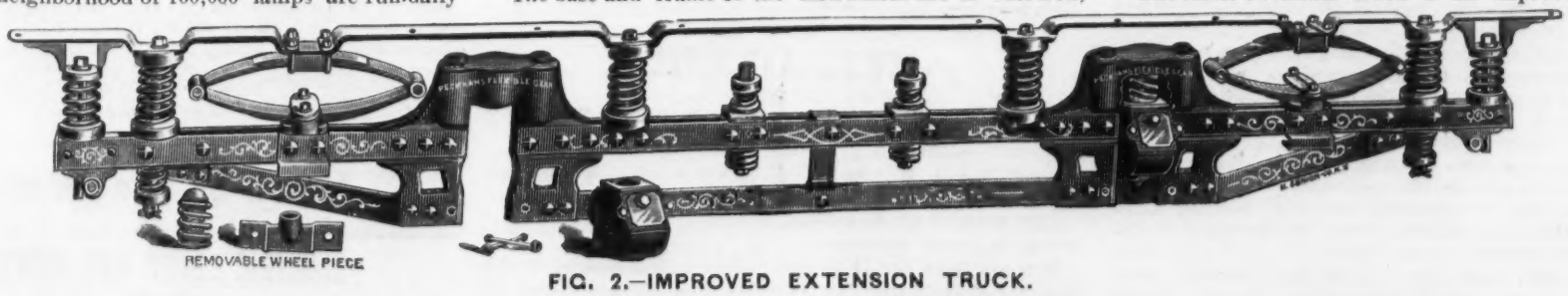


FIG. 2.—IMPROVED EXTENSION TRUCK.

feet long with a distance of 14 feet from centre to centre of end springs with a 6-foot 6-inch wheel base. The new truck is especially designed for 20-foot closed and 32-foot open cars, being provided in the latter case with extra truss extensions.

The truck is equipped with the Peckham spiral spring cushioned gear, the same as used with their 6-A type, and has the same general arrangement of springs except that one more spiral spring is added to each end. Like all the trucks manufactured by this company, it is constructed entirely with hot rivets carefully driven by skilled boiler-makers, and all parts are machine fitted to steel templates, to insure accuracy and make them interchangeable. As a consequence no marks at all are required for fitting when shipped, recent shipments to South America, California and other distant points having most satisfactorily demonstrated this.

Fig. 2 is a skeleton view of the side frame of the truck, which consists of steel bars riveted hot to pedestals or yokes and supported from underneath at their extended ends by steel cantilever truss bars. The removable wheel pieces, when in place, make the truss continuous from end to end. It may be remarked that the mechanical construction of this side frame is the same in principle as that employed in cantilever bridges.

One of these trucks will be shown at the Milwaukee Convention, supporting a car manufactured by Lewis & Fowler for the Brooklyn City Railroad Company, which company is now using the new truck under all of its 20-foot cars.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Oct. 14, 1893.

THE ELECTRICAL STOCK MARKET has been marked with dullness and a slight depreciation throughout the week. Stocks varied slightly the first few days, but the action of Congress cast a shadow over the street, and electrical securities broke several points. Their decline, however, was not as pronounced as other industrials. There has been a great change in the position of electrical stocks on the market. A few months ago some of the electric stocks were the most conspicuous on the list in the trading and speculation. They now seem to be unheard of, and other industrials have forged to the front. Interest in them will undoubtedly return when the market shows more activity.

GENERAL ELECTRIC QUOTATIONS were strong during the early part of the week and looked as if they might appreciate somewhat during the course of the week's trading. But on Friday, in company with other industrials, on the receipt of the news from Washington, the stock dropped three points, bringing the quotation down to 42½. The decline is thought to be entirely due to the silver legislation. Rumors of financial troubles in the company's affairs and other stories of mismanagement are now less frequent.

WESTERN UNION has issued its annual report, which makes a favorable showing compared with the preceding year. The report does not show a loss of trade during the summer. This is a surprise to many financial people, as it was thought Western Union business had fallen off considerably. The report gives a net revenue of $7,496,037, and upon deducting dividends and sinking fund, leaves a surplus for the year of $1,930,841. The stock is now quoted at 80½.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	20	40
Detroit Electrical Works	10	2	3
East River Electric Light	100	..	65
Electric Con. & Supply Co. pref.	15	15	16
" " " " com	15	15	17½
Edison Electric Ill., New York	100	90½	94
" " " 1sts	...	104	105
Edison Electric Ill., Brooklyn	100	93	100
" " " Boston	100	115	130
" " " Chicago	100	220	230
" " " Philadelphia	100	120	125
Edison Electric Light of Europe	..	2½	5
" Bonds	..	80	85
" Ore Milling	..	5	12
Fort Wayne Electric	..	5	6
General Electric Company	100	42⅛	42¾
" " deb. 5's	..	74	75
Interior Conduit and Ins. Co	100	25	35
Mount Morris Electric	..	..	65
Westinghouse Consolidated	50	21	22
" pfd	50	41	43

NEW INCORPORATIONS.

THE MARLBOROUGH ELECTRIC LIGHT COMPANY, Marlborough, N. Y., capital stock $20,000, has been formed to supply electric light and power. O. B. Whitney, Moses McMullen and E. E. McNamee, all of Marlborough, are the promoters.

THE EGAN ELECTRICAL COMPANY, Chicago, Ill., capital stock $60,000, has been formed to manufacture and use all kinds of electrical machinery, devices, etc. The organizers are R. L. Duvall, C. E. Egan, G. P. Jones and B. C. Caldwell.

THE OVERBROOK ELECTRIC COMPANY, Philadelphia, Pa., capital stock $10,000, has been formed to supply light, heat and power by means of electricity to the public in Philadelphia. J. W. Paul, Jr., E. T. Stotesbury, Philadelphia, and W. Wendell, Wayne, Pa., are the promoters.

THE LANCASTER INVESTMENT COMPANY, Seattle, Wash., capital stock $100,000, has been formed to operate electric light plants, etc. The promoters are G. H. Danner, M. F. Phantz, D. L. Hamaker, Manheim, Pa; J. F. Eshelman, C. W. Cropp and James Skinner, Seattle, Wash.

THE HILLSBORO ELECTRIC LIGHT AND WATER COMPANY, Hillsboro, Ore., capital stock $40,000, has been formed to maintain and operate an electric light and water plant in the city of Hillsboro. H. V. Gates, D. Kankin, H. M. Gates and W. E. Pruyn, Hillsboro, Ore., are the organizers.

THE WENSTROM ELECTRIC COMPANY, Baltimore, Md., capital stock $1,000,000, has been incorporated to manufacture electrical machinery and supplies, generate and supply electricity, and maintain poles and wires, and lay conduit. Those interested are J. P. Smith, F. C. Latrobe, B. Ronnert, J. W. Denison and J. E. Senmes.

THE ELECTRIC HEAT REGULATOR COMPANY, Minneapolis, Minn., capital stock $40,000, has been formed to manufacture rheostats, motors and electrical devices for regulating heating apparatus, etc. J. H. Ames, St. Paul, A. B. Robbins, W. F. Decker, W. R. Sweat and C. A. Magnuson, Minneapolis, Minn., are interested parties.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Oct. 14, 1893.

MR. H. WARD LEONARD left New York on Oct. 9 for a week at the World's Fair.

MR. A. W. FIELD, vice-president of the Peckham Truck and Wheel Company, is in Chicago.

ROBERT J. SHEEHY has succeeded the Equitable Manufacturing and Electric Company, and is making a specialty of the Sheehy Telotype.

CAPT. W. L. CANDEE, of the Okonite Company, New York, is attending the American Street Railway Association's Annual Convention at Milwaukee, Wis.

THE BOIES STEEL WHEEL COMPANY, of Scranton, Pa., have rented their office in the Taylor Building, 39 Cortlandt street, but may take it again in a few months.

THE CROCKER-WHEELER ELECTRIC COMPANY have just put out their 30 and 50 kw. multipolar machines, which are the first extra large machines they have made.

MR. WM. C. CALLMANN, of Wm. C. Callmann & Co., 136 Liberty street, New York City, has just returned from an extended and most successful business tour throughout Pennsylvania.

MR. JOHN I. HART, city salesman for Wm. C. Callmann & Co., 136 Liberty street, New York City, reports large sales of the Phoenix lamp and other electrical specialties handled by his company.

MR. JAY HOLMES, whose office is in the Taylor Building, has taken the New York agency for the Jackson Manufacturing Company, of Harrisburg, Pa., and the Lancaster Peerless Emery Wheel Company, of Lancaster, Pa.

MR. W. J. NEWTON, manager of the Newton Electric Company, formerly the Clamp Socket Manufacturing Company, went to Chicago on Oct. 12 to see the World's Fair and establish a Western agency, remaining there about two weeks.

MR. EDMUND J. DALTON, general sales agent for the Davidson steam pump and pumping machinery, 77 Liberty street,, New York City, has returned looking hale and hearty, having spent some three weeks among the Adirondack Mountains.

MR. DAVID CHALMERS, for several years with Alexander, Barney & Chapin, 20 Cortlandt street, has been placed in charge of the stock and affairs of that company, as assistant and representative of S. W. Milbank, the receiver. An account of stock is now being taken preparatory to placing the same on sale, which will probably be within a few days.

THE MAYOR, at the late meeting of the Board of Estimate and Apportionment, overruled Comptroller Myers' vote against a new police signal system. $500,000 was asked, and the statement made that the system complete would cost at least $1,000,000. The comptroller strongly objected to the appropriation because the system to be employed had not yet been decided upon, but $250,000 was voted over his veto. The legality of the proceeding will probably be tested in court.

CONGRESSMAN TOM L. JOHNSON, of Cleveland, after nine years of preliminary litigation, has just had a decision from the New York Court of Appeals ordering a jury trial of his claim of $325,000 damages against Deacon Richardson's Atlantic Avenue Company, of Brooklyn. The litigation had its origin in a lease by the latter to Congressman Johnson of the right to build a street car line in Brooklyn. After expensive preparations it was found that the franchise was claimed by another company.

MR. CHAS. A. SCHIEREN, so well known among the electrical fraternity as the manufacturer of perforated leather belting, has been nominated for mayor of the city of Brooklyn by the Republican party. While the county in which Mr. Schieren resides (Kings) is considered a particularly strong Democratic one, recent charges against the present mayor, Mr. Schieren's opponent, together with internal dissensions in the party now in power, make it more than probable that Mr. Schieren will be elected Nov. 7. The Electrical World extends to Mr. Schieren its best wishes for his success.

PITTSBURGH NOTES.

PITTSBURGH, Pa. Oct. 12, 1893.

THE EAST END ELECTRIC LIGHT COMPANY, of this city, has declared a quarterly dividend of 1¼ per cent., payable on the 16th of this month.

THE PITTSBURGH ELECTRIC COMPANY asked the local council last Monday for the right to enter upon any and all of the streets of the city for supplying light, heat and power.

THE DUQUESNE TRACTION COMPANY, of this city, is now building inclosures around the platforms of all its cars in order to shelter the motormen and conductors during the coming winter.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Oct. 13, 1893.

ALBERT & J. M. ANDERSON have removed to No. 289 and 293 A street.

THE SCHUYLER ELECTRIC COMPANY, Middletown, Conn., is soon to resume operations.

THE SOCIETY OF ARTS held its first regular meeting at the Institute of Technology last Thursday. Prof. Gaetano Lanza, of the Institute, read a paper on "Engineering Education."

THE GREENFIELD ELECTRIC LIGHTING COMPANY is now using 200 h. p. from the steam plant, and contemplates putting in another engine.

H. A. CHASE, who has been the electrician of the Boston Police Department since 1887, received promotion by being appointed director of the whole signal service used by the department. The promotion was caused by the recent retirement of Lieut. H. O. Goodwin.

THE FINANCIAL STRESS of the present year has done much to nip numerous electric street railway schemes in the bud. Orange and Athol were almost certain that they would be connected by an electric railway before winter set in, but the ground has not been broken, and the people of the two towns will count themselves lucky if the road is in operation before the middle of next summer. The road that was to have connected Greenfield and Turner's Falls is also still a thing of the future. What the proposed great electric power station to be located at Conway will do for that section of the State is still a matter for conjecture. The plant is to be operated by water power, and those who are backing the scheme say there is no doubt about dividends from the beginning. One of its sources of income is expected to be the furnishing of power to several proposed electric roads to be built in its vicinity, but of course there will be no income from this source till the roads are built, and the roads cannot be constructed until money is more plentiful than it is now. There are numerous other electric schemes in New England that are lying dormant because it is impossible to secure the money necessary to make them actualities.

CANADIAN NOTES.

OTTAWA, Oct. 12.

TORONTO.—A system of freight trains on some of the suburban electric roads is to be introduced.

LONDON, ONT.—The city authorities have decided to build one or more electric ambulances for use in street car and other accidents. The street railways have consented to supply power and free use of their tracks, and the car will be switched and run to any point desired.

PETERBORO, ONT.—The Town Council has passed a by-law bonus of $50,000 to the Canadian General Electric Company upon their locating there all the industries in Canada controlled by them. The chief addition to the present works will be the lamp factory now in Hamilton.

OTTAWA, ONT.—A charter has been granted William Wylie, car builder; Thomas Ahearn and Warren Young Soper, electricians; John McRae and William S. Miller, of Ottawa, for the purpose of manufacturing railway cars, street cars, snow plows, snow sweepers, omnibuses, carriages, trucks and other vehicles, to be known as the "Ottawa Car Company (Limited)," with a total capital stock of $200,000.

TORONTO.—The Ball Electric Light Company has for a year been controlled by the Canadian General Electric Company, and lately the latter firm has taken the business over entirely. This week the plant in the Pearl street factory will be moved to Peterboro. Thirty-five or 40 men are employed at the Ball factory. The electric lamp factory, Hamilton, owned by the Canada General, will also be moved to Peterboro.

FREDERICTON, N. B.—Since the City Council canceled negotiations with Mr. Calkin for electric lighting, negotiations have been opened with the local company for this service. At a joint meeting of the city light committee and the directors of the Electric Light Company the company have offered to furnish 50 lights at $52 a year, to run all night, and in case the contract for gas is renewed the company want a contract for not less than three years.

OTTAWA, ONT.—The Minister of Customs has received the official report from Collector O'Hara, of Montreal, of the seizure of the Auer Electric Light Company's stock. According to this report the actual value of the goods imported was $8,500, while the special invoices presented by the firm's manager at the customs house represented the value to be only $2,400. This seizure will probably cost the company the value of the whole consignment plus 20 per cent. duty, or a total of $10,200.

MONTREAL, QUE.—A. O. Granger, late of the Auer Light Company, has entered an action against Mr. Bell, acting manager of the company, for $10,000 damages. Mr. Granger alleges that in the course of a conversation between himself and Mr. Bell, held in the presence of some of the clerks, in the Auer Light Company's offices at the time of the customs trouble, Mr. Bell applied several injurious epithets to him, calling him "forger" and similar names. Hence the action.

LONDON, ONT.—The plant of the Canadian General Electric Company is nearly completed. Within the last week the boilers—three in number—arrived. They were manufactured by the Robb Engineering Company, of Amherst, Nova Scotia, weighing 15 tons each. The engines are also three in number, and were made by E. Leonard & Sons. Two of these are 200 h. p. each, the third being 100. These are of the Leonard-Ball make, cross compound, the cylinders being 13 and 22, and the stroke 14.

HALIFAX, N. S.—Tenders for lighting the city by electricity have been opened. Instead of a tender from the gas company was a letter saying that because of a certain action of the City Council the company would not tender. A tender was opened from the Halifax Illuminating and Motor Company. Three propositions were embodied in it. The first, as below, is based on specifications drawn up by the city, the other two originate with the tendering company. They are as follows: 1st, 100 2,000-c. p. arcs, $78.74 each; 50 1,200-c. p. arcs, $72.67 each; 100 50 or 32-c. p. incandescents, $23.27 for 50's and $17.52 for 32's. 2d, 100 2,000-c. p. arcs; 400 50, 40 or 32-c. p. incandescents for an aggregate of $16,044.55. In this connection the city is to have liberty to substitute for 2,000-c. p. arcs, 1,500-c. p. arcs, when the aggregate price will be $15,523. If 1,200-c. p. arcs are substituted for the 2,000-c. p. lamps, the aggregate price will be $15,327. If 800-c. p. arcs are substituted the price will then be $15,156. All extra arcs of whatever candle power required to be furnished at $70. All extra incandescents furnished, if 50-c. p., at $21.16; if 40-c. p., then $19.27 each, and if 32-c. p., at $15.97. 3d, the company will furnish 215 2,000-c. p. arcs at $78.56 per lamp per year, or 215 1,200-c. p. arcs at $71.27 per lamp, or 215 1,500-c. p. arcs at $75 per lamp, or 215 800-c. p. arcs at $68 per lamp.

News of the Week.

ELECTRIC LIGHT AND POWER.

CHATSWORTH, ILL., is to have the electric light.

SMITH'S FALLS, ONT.—The town proposes to put in an electric fire alarm.

SUSQUEHANNA, PA.—The Strarrucca House is to be wired for electric lighting.

TILBURY CENTRE, ONT., CANADA, has decided to purchase an electric light plant.

RUSSELLVILLE, KY., has granted an electric light franchise to a company composed of W. F. Browder and others.

WAUWATOSA, WIS.—The ordinance for an electric lighting plant has passed the Board of Village Trustees.

COAL, MICH.—The citizens are discussing the advisability of putting in an electric light plant and water-works.

BELFAST, WALDO COUNTY, ME.—The County Commissioners are considering the matter of putting an electric lighting plant into the jail.

COLORADO SPRINGS, COLO.—The Council is considering the matter of an electric lighting plant. The present contract expires this month.

SAVANNAH, GA.—Authority will be asked for, by the city, of the legislature to operate an electric light plant in connection with the water-works.

ROCKINGHAM, N. C.—Arrangements will be made by J. E. Durval, of Charleston, for the erection of a central electric lighting station at Rockingham.

PIKE, WYOMING COUNTY, N. Y.—A plan is being agitated here to utilize the water power on the site of the woolen mill for an electric light plant by a stock company.

BRIGHTON, IA.—The citizens of Brighton are discussing the project of electric lights for the town. They think it possible to utilize the river for water power at a nominal expense.

NEW WESTMINSTER, B. C.—This city has its own lighting plant. The report of the civic electric light department for the past year show receipts, $6,112; expenses, interest and sinking fund, $5,204; net profit, $908.

HOMESTEAD, PA.—An explosion in the power house of the electric light works completely wrecked the building and machinery, and the entire plant is practically ruined. There will be no electric lights for a month.

SPRINGFIELD, MO.—The franchise of the electric light company expires in one year, and the City Council now proposes to build and operate its own electric lighting plant. A location will be secured at once and bids for the building and plant will be advertised for.

LYONS, ILL.—The Village Board has passed an ordinance granting to H. K. Gillman, of Riverside, a franchise to operate an electric light and power plant. The village will, however, continue to be lighted by the present system, the board not feeling in a financial position to put in electric lights.

OLYPHANT, PA.—A special election will be held on Nov. 7 to vote on the matter of increasing the borough indebtedness by $10,000, to pay for the proposed electric lighting plant, to be either arc or incandescent lights, as may be desired and found expedient. M. W. Cummings, Jr., is secretary of the Borough Council of Olyphant.

BLACK ROCK, N. Y.—A high-class summer resort is to be established on Grand Island, and a company has been formed to develop the spot. A $15,000 hotel with tower will be built and a complete water-works' system introduced, and there will also be an electric lighting plant. Among those interested are James Lutted, Charles Richardson and Dr. N. Osborne, of Black Rock, N. Y.

NEWTON, MASS.—The Street Lighting Committee of the Newton City Council is preparing a report covering the advisability of purchasing an entire new plant and also the cost of the present plant of the Newton & Watertown Gas Company, which now has the contract for supplying this city with both gas and electric lights. It is believed that the city cannot legally be compelled to purchase the existing plant, as it lies outside the city limits and is wholly in Watertown.

WATERBURY, VT.—Proposals will be received by the trustees of the Vermont State Asylum, at Waterbury, for the following work in connection with buildings now in process of erection: For the necessary electric light plant, including engines, dynamo, tubing, wiring, and lighting apparatus for the new buildings at the Vermont State Asylum at Waterbury. Plans and specifications may be seen at the office of W. H. Giddings, superintendent, at Waterbury, and bids will be received to Oct. 26.

HUMBOLDT, TENN.—A meeting has been held by the mayor and aldermen of Humboldt to consider the question of a system of water-works and electric light. An election was ordered by the board to be held Nov. 24 to decide if a proposition made by a firm in Memphis shall be accepted. The proposition is if the city of Humboldt will grant a 25-year franchise and bonds to amount of $25,000 they will build such a system of water-works and electric lighting as will be in every way suitable to the needs of the town.

OTTAWA, ONT.—The civic authorities are now looking into the question of the city doing its own electric street lighting. The city now pays on an average $80 a year for each light, or $24,700 in all. The company pays some $5,000 a year for wages, $2,030 for carbons and renewal of lamps, and about $3,438 for water. The water is supplied at the rate of five cents for each lamp per night to the extent of 100 lamps and three cents per night for each additional lamp. There are 316 city lamps. Without counting wear and tear on plant, the cost of supplying the city lights is, at this rate, $10,468.

THE CLINTON (IA.) GAS LIGHT AND COKE COMPANY have started their new electric plant which they claim to be one of the best and most economically operated installations in the country. It is composed of two Bass engines 22 inches by 48 inches and 18 inches by 42 inches belted to a shaft 50 feet long, made by the Rivet Company; four 50-light arc machines, one 1,200-light Thomson-Houston alternator, one 1,500 Wood alternator, and one 60-light Wood arc. The plant was designed by Messrs. S. M. and E. M. Highlands. The rates charged are as follows: Arc Lighting.—Running till 9 p. m., and later on Saturday and pay nights, six days per week; one light, 88; two lights, $16; three lights, 22.50; four lights, $30; five lights, $35; all additional lights, $7 each. Lights till 11 p. m., $10 per month each. Incandescent Lighting.—All renewals to be paid by consumers at 60 cents each. Lamps, 16 c. p.:

Running till 11 p. m.			Running all night.			Residence lighting.		
		Tot'l			Tot'l			Tot'l
1st light..	$1.25	$1.25	1st light..	$1.50	$1.50	1st light..	$1.00	$1.00
2d " ..	1.15	2.40	2d " ..	1.40	2.90	2d " ..	90	1.90
3d " ..	1.05	3.45	3d " ..	1.30	4.20	3d " ..	80	2.20
4th " ..	95	4.40	4th " ..	1.20	5.40	4th " ..	70	3.40
5th " ..	85	5.25	5th " ..	1.10	6.50	5th " ..	60	4.00
6th " ..	75	6.00	6th " ..	1.00	7.50	6th " ..	50	4.50
7th " ..	75	6.75	7th " ..	1.00	8.50	7th " ..	40	4.90
8th " ..	75	7.50	8th " ..	1.00	9.50	8th " ..	30	5.20
9th " ..	75	8.25	9th " ..	1.00	10.50	9th " ..	25	5.45
10th " ..	75	9.00	10th " ..	1.00	11.50	10th " ..	25	5.70
All additional lights 75 cents each.			All additional lights $1 each.			All additional lights 25 cents each.		

To consumers of arc lights for windows and other purposes, 11 o'clock incandescent lights, 75 cents each. Meter lighting one cent per hour each.

THE ELECTRIC RAILWAY.

MIDDLETOWN, N. Y.—Ground was broken Oct. 9 for the proposed Middletown-Goshen electric street railway.

CARTHAGE, MO.—H. T. Harrison is interested in the project to build an electric road between Carthage, Carterville and Joplin.

PORT VIEW, PA.—The Council is considering the application of the McKeesport & Port View Traction Company for right of way.

LEAVENWORTH, KAN.—Newman Erb has been appointed receiver of the dummy railway line, and it is his intention to equip with electricity.

HADDONFIELD, N. J.—The petition of the West Jersey Traction Company to build a trolley line is being discussed by a special committee of 15 citizens.

CHESTER, PA.—The People's Street Railway Company has been granted permission to build and operate an electric street railway on the streets of Chester.

WINNIPEG.—An electric railway is projected between Winnipeg and Selkirk, for which a charter has been granted. The enterprise waits until funds are provided.

NEW CASTLE, DEL.—The Levy Court has granted the right of way to the New Castle & Wilmington Electric Railway through portions of the New Castle causeway.

WEST CHESTER, PA.—Survey has been completed by Engineer J. C. Sharpless for the proposed West Chester & Philadelphia Electric Railway, to be about 23 miles long.

ALDEN, N. Y.—A survey has been made through this place for the proposed trolley line from Lancaster to Rochester. The line takes in nearly all the villages lying back from the rail road.

BRISTOL, CONN.—The Bristol & Plainway Tramway Company has been organized. Noble E. Pierce is president, and C. S. Treadway secretary. The company hopes to commence the work of construction this fall.

PORT RICHMOND, STATEN ISLAND, N. Y.—A meeting of business men held at the office of Justice Jacobs collected quite a large sum for the proposed extension of the line of the Prohibition Park Electric Railway to Castleton Corners, and another meeting will be held Oct. 18.

SAN DIEGO, CAL.—The Pacific Beach motor road, running to Pacific Beach, has applied for a franchise to extend the road to La Jolla Park, several miles up the coast. Malcolm Forbes, of Boston, Mass., is owner of the road, and he proposes to extend it in the spring to Escondido.

BROOKLYN, N. Y.—At the meeting of the Brooklyn Bridge Trustees, Superintendent Martin presented a report of his recent examination of the electric traction system at the World's Fair. He advocated the adoption of this system on the bridge. The matter will be determined at the November meeting.

PITTSBURGH, PA.—The Philadelphia "Record" is authority for the statement that $125,000 out of $175,000 needed has been subscribed by the farmers of Neville Island, near Pittsburgh, for an electric road, to run the length of the island, each farmer to have a freight car. No names have yet been mentioned.

GALT, ONT.—At a meeting of the directors of the Galt & Preston Street Railway Company, Limited, held at Galt, it was unanimously decided to operate the road by electricity. Thos. Todd and T. Burt were appointed a committee to investigate the various systems and report to the company the cost of such a plant as will be needed.

TRURO, N. S.—The Town Council has adopted a resolution recommending that a meeting of the rate payers be called to authorize the Council to apply to the legislature of Nova Scotia for authority to grant exemption from municipal taxes on the real and personal property of the proposed electric street railway company for the term of ten years.

KINGSTON, ONT.—There is a possibility that before long the Thousand Island Railway at Gananoque will be converted into an electric road, and steam as a motive power done away with altogether. The company is considering a proposition submitted by J. M. Campbell, of the Kingston Electric Light Company. The Kingston Street Railway is being changed to electricity, and on Saturday cars began running on Princess street.

PORT ARTHUR, ONT.—Port Arthur's electric railway is now completed. It connects the three towns, Port Arthur, Fort William and West Fort William, and is eight miles in length. Through trains run from the Canadian Pacific Railway station, Port Arthur, to the station at West Fort William. The road was built, is owned, and will be operated by the town of Port Arthur, Fort William having the right to buy one-half at any time within five years.

VANCOUVER, B. C.—Articles of association of the Vancouver & New Westminster Electric Tramway and Light Company are published in this week's "Gazette." The capital stock is $2,500,000, divided into 20 shares, and D. Oppenheimer, Benjamin Douglas and Percy A. Smith are the incorporators. The new company will take over the business of the Vancouver Electric Railway and Light Company and the Westminster & Vancouver Tramway Company.

NIAGARA FALLS, N. Y.—Charles Black, manager of the Niagara Falls Street Railway, which now runs from Niagara Falls to Niagara Falls South (Drummondville), states that not only will electric power be put in but that the line will be extended to Chippewa and Niagara-on-the-Lake, and they will also build a branch to Lundy's Lane, from Niagara Falls South. This will give them a road about 20 miles long, and they will then be a strong rival to the Niagara Falls River Railway.

PERSONAL NOTES.

MR. W. H. PREECE writes to a friend in New York that he has arrived safely in London after a pleasant voyage.

MR. W. F. C. HASSON has been appointed consulting electrical engineer of the San Francisco Midwinter Exposition.

MISCELLANEOUS NOTES.

CAR FENDERS.—It is claimed that 15 lives have been saved in Buffalo since the adoption of a simple safety fender or life guard on trolley cars.

MILITARY TELEGRAPHERS.—Senator Hill has introduced a bill into Congress to recognize the faithful services of those who served as army telegraphers during the Rebellion.

RAILWAY SIGNALS.—Mr. J. D. Taylor, of Piketon, O., has invented a new system of railway signals in which a fan with four large blades revolves when a track is clear and remains stationary to indicate danger.

PENNOCK'S BRIDGEPORT (CONN.) COMPANY'S PLANT was attached by the sheriff on Oct. 10. Pennock said he did not care very much, because he sold his right to the other stockholders for $2,000, and received the money.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS will hold its 80th meeting at headquarters, 12 West Thirty-first street, New York City, on Wednesday, Oct. 18, at 8 o'clock p. m. The following papers will be presented: "Hedgehog Transformer and Condensers" (An Experimental Investigation), by Dr. Frederick Bedell, K. B. Miller and G. F. Wagner, of Cornell University; "Monthly Meetings of the Institute; Their Origin and Proposed Development," by Ralph W. Pope, of Elizabeth, N. J.

THE FRANKLIN INSTITUTE, in the city of Philadelphia, has just published its announcement of the programme of the public lectures to be delivered there during the coming winter. Among them are only two on electrical subjects: One on Friday, Dec. 22, by Prof. Elihu Thomson, on "Induction Coils and Condensers"; another on Friday, Jan. 19, 1894, by Prof. F. B. Crocker, on "The Electric Motor." There is another which may be of interest indirectly to electricians, on Friday, March 23, 1894, by Prof. Edward Hart, of Lafayette College, Easton, Pa., on "Carbon: How Many Forms Are There?" The special attention of our readers is called to Prof. Thomson's lecture, which promises to be one of the most interesting lectures of the course.

MR. T. D. LOCKWOOD read an interesting paper on "The Influence of Electrical Inventions" before the Congress on Patents, held at Chicago, on Oct. 4. He refers particularly to the invention of the telegraph and telephone as having had an enormous influence on the destinies of mankind, and statistics are given to support the view. Electric light and power are also shown to have had wide, beneficial effects aside from their mere convenience. After a reference to the United States patent system the author concludes that our pre-eminence in electrical invention is the logical outcome of the fostering care of its wise and liberal policy.

Trade and Industrial Notes.

THE BACKUS WATER MOTOR COMPANY, Newark, N. J., has issued a catalogue describing the different forms of the Backus gas engine, and showing its advantage and the different uses to which it may be applied with a great saving.

THE KINSMAN BLOCK SYSTEM COMPANY, 96 Broadway, recently equipped 26 miles of track for the Chicago, Milwaukee & St. Paul Railway Company with their system, and two apparently inevitable collisions have thus far been prevented by it.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., has closed a contract with the New Home Sewing Machine Company, at Orange, Mass., for a new foundry and tumbling room. The building will be entirely of iron, 45 ft. in width and 120 ft. in length.

MESSRS. BERGTHEIL & YOUNG, 13 Walbrook, London, E. C., are the sole European agents for the Mica Insulator Company, New York manufacturers of "Micanite." Micanite seems to have met with flattering success on the other side, if orders received from Messrs. Bergtheil & Young can be considered as a criterion.

MR. WILLIAM OSWALD, of New Orleans, has returned to that city after a five-months trip to Europe and the World's Fair. Mr. Oswald has resigned his position as general manager and secretary and treasurer of the Southern Electrical Manufacturing and Supply Company, of New Orleans, and will open a new supply house at 193 Erato street.

THE JEROME KIDDER MANUFACTURING COMPANY, 820 Broaway, New York, has received a letter from Dr. J. H. Ginley, of Coopersville, Mich., under date of Sept. 26, 1893, in which the doctor says, "I have bought some half dozen of your instruments, and I find them the most reliable batteries after testing them for over 25 years. I always advise my friends to buy yours and no others."

THE AMERICAN BATTERY COMPANY, 188 Madison street, Chicago, Ill., received the only award given to any storage battery in this country. The award states that after being examined and tested by the jury, one of whom was Prof. Stine, of the Armour Institute, they found the "American" battery worthy of an award for its excellence of design and construction, as well as for its efficiency and indications of durability.

"M. V." AMMETERS AND VOLTMETERS.—Queen & Co., Incorporated, of Philadelphia, are much gratified because of the recent award granted to them for "Magnetic Vane" ammeters and voltmeters, because of "Excellence of design and construction, and convenience in use." A number of construction companies have adopted them to install with dynamo machinery, and the makers will be glad to furnish further particulars to interested parties.

THE STUCKY & HECK ELECTRICAL MANUFACTURING COMPANY, 23 and 25 New Jersey Railroad avenue, Newark, N. J., is working to its utmost capacity. This company makes a specialty of repairing and reconstructing dynamos and motors, and in fact any electrical apparatus. Having had some 16 years' experience in this particular branch of the business—repairing—this company is fully capable of undertaking and accomplishing the most difficult of work.

THE J. A. FAY & EGAN COMPANY, of Cincinnati, O., received an award at the World's Fair which is the latest of the long line of awards from 1851 down to the present time, including the Grand Prix, at Paris, in 1889. The judges decided that the woodworking machinery of this company possessed the most essential conveniences and embodied the latest results of American ingenuity. The exhibit of the company included sandpaper, boring, cut-off saw, and flooring machinery and, in fact, almost every variety of wodworking apparatus.

THE FIELD ENGINEERING COMPANY, 143 Liberty street, New York, has published a handsome 9-inch by 11-inch pamphlet devoted to the description of vertical multi-cylinder engines for electric service. The covers, paper, composition and presswork are of a grade usually only met with in fine art publications. The engines described are those of the Lake Erie Engineering Works, and are of the vertical marine type, both compound and triple expansion. Several tables on the power and economy of different types of engines and under different conditions will be found interesting by engineers.

THE CENTRAL ELECTRIC HEATING COMPANY, Havemeyer Building, New York City, reports increasing confidence among business men, and, naturally, increasing orders. The car heating department is now taxed to its utmost to turn out orders. Nearly all of the 60 odd roads who used heaters last year are ordering for the entire equipment of their roads. The Cincinnati, Newport & Covington Electric Railroad recently placed an order for the equipment of 55 of their cars. Mr. Geo. Cutler, manager of the Western Electric Heating Company, Chicago, and Mr. E. D. Wyman, manager of the Central Electric Heating Company, New York, will both attend the annual

convention of the American Street Railway Association, being held at Milwaukee, Wis., this week.

THE GREAT WESTERN MANUFACTURING COMPANY, which recently secured the $225,000 contract at Atchison, Kan., for both the electric light and railway installations, has been appointed general Western agent for Clark's well-known rubber covered wires and cables. In addition to this important agency, this firm has perfected arrangements for the manufacture of its H. G. triple braided, weatherproof wires, as well as all styles and sizes of magnet wire and flexible cord. The works of the company at West Duluth, Minn., are running to their utmost capacity, and the outlook for fall and winter business is especially bright. They are now in a position to handle the complete installation and equipment, not only of electric lighting stations, but street railway systems of any size.

THE MICA INSULATOR COMPANY, of New York and Schenectady, will make a fine display at the meeting of the American Street Railway Association in Milwaukee. This will be the first time that this company has made an exhibition of micanite. Micanite is surely and steadily being adopted as a reliable insulator, not only in the United States, but in Europe. This company has made several important improvements in the method of manufacturing, and is very happy to say that micanite of to-day is far ahead of what was put on the market when they first began business. The exhibit will be in charge of Mr. Charles W. Jefferson, their manager, who is thoroughly posted on insulation. Mr. Jefferson was for several years manager of the insulating department of the Edison General Electric Company, at Schenectady.

AN IMPORTANT ORGANIZATION.—The Western Electric Heating Company has recently been organized in Chicago, by Mr. George Cutter, to manufacture and sell electric car heaters, as well as electric cooking devices, under the patents now controlled by the American Heating Corporation. It will be remembered that the latter company has been organized for the purpose of controlling the different types of electric heating apparatus in the United States, and the Western Heating Company will operate under these patents, its particular territory being the West. With such an energetic man as Mr. Cutter, and with so many kinds of heaters that have been thoroughly tested, and somewhat generally adopted in different sections of the country, the Western company will start in business with the brightest prospects. A large and very complete factory has been established in Chicago, and orders for any style heaters, in any quantity, can be promptly taken care of.

THE CARD ELECTRIC MOTOR AND DYNAMO COMPANY, Cincinnati, O., has just installed in the Chamber of Commerce Building, Cincinnati, two 45-kw. dynamos. These machines were substituted for others, and the engineer reports a saving of 1¼ tons of coal per day through their use. The Card company through its agent, the Southern Engineering Company, of Louisville, Ky., has put in two 300-light incandescent machines for Levy Brothers, of that city, including switchboards and all the necessary apparatus. Among other sales are a plant to the Quick-Meal Stove Company, St. Louis, Mo.; a 500-volt Card motor to the Smith & Davis Manufacturing Company, St. Louis, Mo., and one 45 kw. generator, and a 25-h. p. motor, and several smaller sized motors to the Cincinnati Abattoir Company, for whom they also did the wiring. The Card company feels much gratified by the increase in its business notwithstanding the general depression, and with its new factory and the many improvements introduced into its machinery it feels confident as to the future.

A HANDSOME ISOLATED PLANT.—In the new Palace Theatre, at Allegheny, Pa., a very complete and substantial lighting plant was recently opened which was installed by the Austin Engineering Company, of Pittsburgh. It consists of a nominal 80-h. p. centre crank M. A. Green automatic cut-off engine manufactured by the Altoona Manufacturing Company, Altoona, Pa., for which the Austin Engineering Company is the general agent, and the latest design of multipolar dynamos from the Western Electric Company, which run at a speed of 400 revolutions and have a rated output of 26 kw. The engine is highly finished in white, gold and blue, and can be seen from the lobby through a glass partition. The switchboard, also manufactured by the Western Electric Company, is a highly finished piece of apparatus. The stage regulating mechanism is mounted on marbleized slate, and the rheostats are of the Carpenter enamel type. A 100-h. p. "Economic" boiler built by the Erie City Iron Works, Erie, Pa., completes the steam plant. The entire plant was installed under the supervision of Mr. D. W. Dunn, general manager of the Austin Engineering Company, and reflects great credit upon that gentleman and the company he represents.

GRAHAM'S IMPROVED ELECTRIC TRUCK.—Every one interested in street railway economy realizes that gross errors have been made in the past as regards the construction of car trucks. Mr. J. H. Graham, president of the Graham Equipment Company, of Boston, Mass., has invented a new truck which possesses many advantages. The patent, No. 503,044, was issued Aug. 8, but the trucks have been running with great success since last fall. The officials of the railroads in Providence, New Haven, Bath, Haverhill, Lynn and Boston who are using the truck speak in the highest manner of their easy riding. Mr. G. S. A. Gardiner, president of the Consolidated Railway Supply Company, is one of the largest stockholders in the company. He and Mr. Graham are both to be at the Exposition in Milwaukee where the Equipment Company are going to make an elaborate exhibit of the truck. They have prepared for distribution at the Exposition a booklet, the title of which is "Spring Suspension," the pet hobby of Mr. Graham. The booklet is unique in its way. It says very little and is most tastefully printed. Street railway officials who intend visiting Milwaukee will do well to see this truck. In the Boston "Herald" of Sept. 17: "One thing is certain, Bath has the finest electric trucks in Maine, if not in New England. There is none of that oscillation which troubles so many cars. Though they have to make a round trip of nine miles every hour, the motion is perfectly steady." Mr. Graham and Mr. Gardiner are both young in years, but are wide awake and thoroughly active business men with a "get there" determination in every thing they do. The Equipment Company have orders ahead for 250 trucks, and are at present negotiating with two large corporations for their entire equipment. The works are in Boston and are being pushed to their utmst capacity. "The truck is a revelation to all who ride on it."

Business Notices.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

DESK ROOM in the commodious office of The Electrical World, in the new Monadnock Block, Chicago, may be obtained by applying in person or by letter to the office, 936 Monadnock Block.

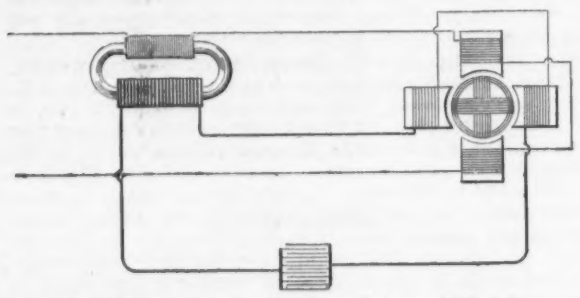
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

UNITED STATES PATENTS ISSUED OCT. 3, 1893

(IN CHARGE OF W. A. ROSENBAUM, 177 TIMES BLDG., N.Y.)

505,808. ELECTRIC TIME CUT-OUT; F. Beland, Cairo, Ill. Application filed July 8, 1893. In an electric cut-out the combination of a cut-out dial having separated rings included in a main supply and working circuit, and one of which has removable contacts, a cut-out ring adapted to be disposed directly under the removable contacts, and a clock mechanism controlled brush.

505,819. FIRE ALARM SYSTEM; H. T. Downs, New York, N. Y. Application filed Oct. 1, 1892. The combination of a system of transmitters at outlying stations, a receiver at common or central station, an alarm circuit controlled by said receiver, a series of electro-mechanical gongs controlled by said alarm circuit, each gong normally disconnecting the next gong from the circuit, but provided with a circuit closing contact to complete the connection when its armature is actuated.

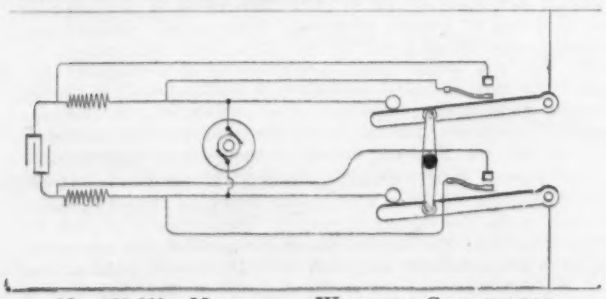


No. 505,859.—ALTERNATING CURRENT MOTOR.

505,822. PROTECTOR FOR PIPES FROM POWERFUL ELECTRIC CURRENTS; F. Egner, St. Louis, Mo. Application filed June 17, 1893. The improved system for protecting gas and water pipes, comprising the combination of wires, of better conducting material than the pipes, laid around or along the same and in close contact therewith, and earth plates of conducting material connected therewith at intervals.

505,833. CONTACT FOR SIGNALING TO CARS; F. E. Kinsman, Plainfield, N. J. Application filed May 26, 1892. The combination of an electrically propelled vehicle and its propelling electric motor, of a handle acting on a suitable controlling apparatus for governing the speed or movement of the motor at will, an electric switch controlled independently of said manual device and governing the circuit of the motor, an electromaguet carried by the vehicle and governing the switch, and means upon the roadbed or permanent way for governing the circuit of the maguet.

505,834. FIRE ALARM; A. Krastin, Cleveland, O. Application filed Jan. 6, 1893. In an electric fire alarm the combination of a pendent alarm head provided with automatically closing clips having serrated meeting edges, clamping plates, a screw with current wires, a signal and a battery.



No. 505,880.—METHOD OF WORKING CONDENSERS.

505,841. CONDUIT ELECTRIC RAILWAY; L. A. McCarthy, Brooklyn, N. Y. Application filed Feb. 6, 1893. In an underground trolley system the combination of an electromagnet suspended from a car and inside an open conduit; with said open conduit and with waterproof tubes or boxes arranged inside the open conduit, normally charged electrical conductors, arranged on the inside of said tubes or boxes, sectional normally uncharged conductors arranged partly inside and partly outside said tubes or boxes, and connecting arms, arranged to be controlled by said electromagnet, and to connect the normally charged with the normally uncharged conductor.

505,859. ALTERNATING CURRENT MOTOR; W. Stanley, Jr., and J. F. Kelly, Pittsfield, Mass. Application filed June 8, 1892. The combination with an alternating current two-phase motor having independent energizing circuits, a main circuit from a source of alternating currents, a transformer, the primary and secondary cells of which are in circuit with the motor coils respectively, and a condenser in series with the secondary coil and one of the motor coils, the transformer being constructed or designed with a greater number of ampere turns in the secondary than in the primary circuit. (See illustration.)

505,880. METHOD OF WORKING CONDENSERS; W. Stanley, J. F. Kelly and C. C. Chesney, Pittsfield, Mass. Application filed March 18, 1893. The combination with an alternate current translating device and a condenser in shunt or derivation thereto, a protective resistance in series with the condenser, and a switch adapted to short-circuit said resistance after closing the main circuit. (See illustration.)

505,911. RHEOSTAT; A. Wurts, Pittsburgh, Pa. Application filed Dec. 22, 1892. In a rheostat, resistance strips composed of wire gauze or netting.

505,912. CLEAT FOR HOLDING INSULATED ELECTRIC WIRES; E. W. Buffington, Fall River, Mass. Application filed June 1, 1893. In a cleat for holding electric wires, a base provided on its upper surface with transverse ribs located directly over the parts crossed by the wires.

505,913. INCANDESCENT ELECTRIC LIGHT; H. D. Burnett, Lynn, and S. E. Doane, Swampscott, Mass. Application filed June 24, 1892. The combination with an incandescent lamp bulb having a supporting tube, of two filling pieces in the tube, and a flat contact pin held between them.

505,914. REGULATOR FOR DYNAMOS; W. H. Elkins, Cambridge, Mass. Application filed Nov. 21, 1892. In a dynamo, main brushes, a regulating brush, means for moving one of the main brushes toward and from the regulating brush, an external circuit, one terminal of which is directly connected to one of the main brushes, and also to its regulating brush and which contains the whole field, and all the translating devices, all combined.

505,916. INSULATING COMPOUND AND METHOD OF MANUFACTURING THE SAME; J. Hoffman, Schenectady, N. Y. Application filed Dec. 2, 1892. A compound composed of asbestos fibre with a binding material consisting of asphaltum, beeswax and shellac.

505,917. TRANSMITTING TELEPHONE; S. W. Holman, Boston, Mass. Application filed May 4, 1895. In an apparatus for converting sound waves into electrical undulations similar thereto in form, a liquid electrode consisting of a thin stratum of conducting liquid maintained under the influence of its surface tension throughout its depth, and a solid electrode adapted to vibrate therein.

505,926. ARMATURE FOR ELECTRIC MACHINES; A. Schmid, Pittsburg, Pa. Application filed Nov. 3, 1892. In an armature or field magnet for electric machines a series of laminated pole pieces, a support for same, having openings beneath the alternate poles and arms extending from the pole pieces into the openings.

505,927. ALTERNATING CURRENT, GENERATOR; A. Schmid, Pittsburgh, Pa. Application filed Nov. 3, 1892. In an electric machine, an armature, a field magnet and a compensator mounted on the armature and having a magnetic circuit independent of the armature. (See illustration.)

505,928. SYSTEM OF ELECTRICAL DISTRIBUTION; C. F. Scott, Pittsburgh, Pa. Application filed Sept. 28, 1892. In a system of electrical distribution, a generator, a main line feeding translating device, and two potential modifiers having their primary circuits in multiple arc with the main line and their secondaries in series therewith on each side thereof.

505,957. ARMATURE; M. Rahmer, Union, N. J. Application filed Dec. 7, 1892. In an armature, the combination, with a shaft, of two end discs on same, a series of core pieces held radially between the end plates, which core pieces are provided with end lugs at the outer and inner edges, bolts passed through the end plates into the outer lugs of the core pieces and a separate and independent coil on each core piece.

505,994. ELECTRO-CONDUCTING BEARING FOR TROLLEY OR OTHER WHEELS; E. A. Sperry, Chicago, Ill. Application filed Sept. 17, 1891. A wheel and stud upon which the wheel may turn in combination with bearings for the wheel consisting of a commutator brush carbon, collars upon the end of the hub of the wheel consisting of buttons of commutator brush carbon, and a following spring to hold the buttons against the hub of the wheel.

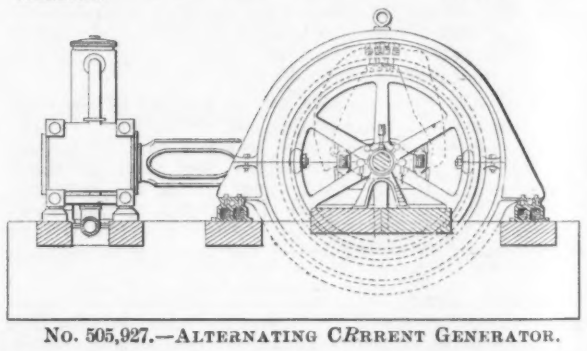
506,001. CONTROLLING DEVICE FOR ELECTRIC RAILWAY CARS; W. P. Coldren, Lebanon, Pa. Application filed April 22, 1893. In an electrical car, a combined brake and current controlling device comprising an electrical switch, a brake shaft, a spring supporting the shaft and an indicator extending through the slot.

506,002. INSULATING SUPPORT FOR METALLIC CIRCUITS; A. C. Cousens, Boston, Mass. Application filed May 6, 1893. A support for the two wires of a metallic circuit, which consists of an insulator for each wire, a common conducting support therefor and an insulator for each wire and an insulator between the support and its sustaining structure.

506,034. INSULATING JOINTS; S. W. Burtchaell, San Francisco, Cal. Application filed June 20, 1892. An improved insulating joint consisting of an upper and lower section adapted to be fitted together, one of the sections having a convex projection traversing the central portion of its end so as to leave a space at each side of it, and the other section having the central portion of its adjacent wings or walls adapted to enter the spaces provided at the sides of the convex projection of the other section, to the other, a washer interposed and adapted to conform to the interlocking meeting surfaces of the opposing sections, and means insulated from one of these sections for connecting them.

506,043. TROLLEY WIRE SUPPORT; M. Hoopes and O. S. Hertzog, Lynn, Mass. Application filed July 1, 1893. The combination of a bracket arm, a clevis pivoted to one end, a suspension wire attached to the clevis and also attached to the opposite end of the bracket arm, and a trolley wire support or insulator secured to the suspension wire. (See illustration.)

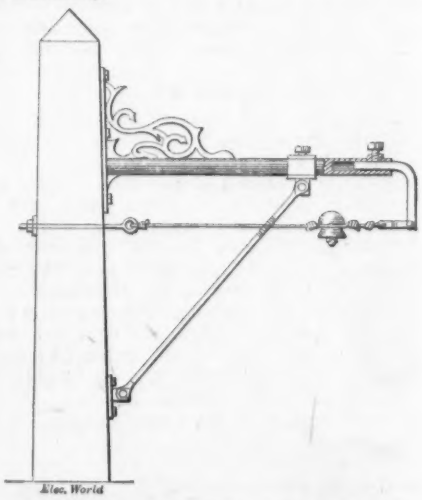
506,066. MEANS FOR DETERMINING THE PRESENCE AND INTENSITY OF ATMOSPHERIC ELECTRICITY; J. Opperman, St. Louis, Mo. Application filed Feb. 15, 1893. This consists in the combination with a collector situated at a relatively elevated position, of an insulated conductor, connected at one end with the collector and grounded at the other end, and a measuring instrument interposed in the length of the conductor.



No. 505,927.—ALTERNATING CURRENT GENERATOR.

506,092. ELECTRICAL SWITCH; C. O. C. Billberg, Philadelphia, Pa. Application filed July 23, 1892. An electrical rheostat switch having electrical contacts, and a switch lever carrying carbon blocks to bear on the contacts, and having extension pieces with metallic plates at the leaving points of the contact plates to engage with the extension pieces in breaking the circuit.

506,124. ELECTRIC RAILWAY SYSTEM; H. A. Lewis, Norristown, Pa. Application filed March 3, 1893. The combination with stationary, horizontally disposed armatures mounted transversely to the direction of the travel, of a suspended coil having a core, and electrical connections including a resiliently supported adjustable trolley wheel, between the coil and a source of electricity.



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No. 506,043.—TROLLEY WIRE SUPPORT.

506,149. ELECTRIC TROLLEY WIRE CROSSING; E. P. Binford, Cincinnati, O. Application filed Nov. 3, 1892. In a crossing bridge for electric railway conductors, the combination of the insulating block provided with a recess on its lower face, a conducting plate fitting in the recess for connecting the wires, an insulating plate hinged to the block for bridging the recess, and a connecting plate provided with insulating depending flanges also hinged to the block.

506,169. ELECTRIC ELEVATOR; E. R. Esmond, New York. Application filed Feb. 21, 1893. In an electric elevator or hoisting apparatus an electric motor comprising a field and an armature, both of them rotatable, an intermediate pinion geared on the one hand to the armature and on the other hand to the field, a carrier for the intermediate vibratory upon an axis coincident with that of the armature, and a hoisting drum mounted on or formed with the field.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1836—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.